VI

THE IMPACT OF VIETNAM AND THE RENEWED EMPHASIS ON EUROPE, 1970–1975

The early 1970s were difficult for the American military in general and the Army in particular. The decade opened with the continuation of the frustrating and intractable war in Southeast Asia and the bitter debate over the war growing ever more strident. Drugs, racial strife, and desertion plagued the Army in Vietnam, and at home critics of the war became more vociferous. As American involvement in Vietnam gradually receded, military budgets declined in real terms, and antiwar pressure forced an end to the draft and its replacement by volunteer service. By the spring of 1973 the United States had withdrawn its troops from Vietnam, but the war left a complex legacy to which the Army had to adapt.[1]

During the same year as the withdrawal from Southeast Asia, the Middle East experienced a short but violent war. For the U.S. Army, that war demonstrated vividly the lethality and destructiveness of the modern battlefield. "The October War," John Rose wrote, "has had the effect of taking the Army out of the rice paddies of Vietnam and directed doctrine, training, and thinking to what the Army has termed the most demanding mission it would be assigned—battle in Central Europe against forces of the Warsaw Pact."[2] With Southeast Asia and counterinsurgency behind it, the Army turned its attention to the neglected European theater and the conventional or perhaps nuclear war it might have to wage there. Army doctrine was thoroughly reevaluated, a process that was not complete until the late 1970s. And in a period of budgetary restraint and increased costs due to the all-volunteer Army, inflation, and expensive weapons systems, the Army placed greater emphasis on managing and improving the use of its resources. Even though the war was over, criticism continued, especially attacks on what some saw as waste and fat in the military system. New problems replaced the old ones associated with Vietnam.[3]

The early 1970s was a period of transition between war and peace, between Asia and Europe, and between plenty and scarcity. In addition to tackling problems left over from Vietnam, the Army had to adapt to a new environment and a new or perhaps renewed mission. The variety of subjects studied by the Engineer Strategic Studies Group reflected the complexity of the tasks confronting the Army. Although the Army's transition was far from complete by the end of 1975, it was struggling to cope with its new circumstances.

* * *

The Nixon administration continued the Kennedy-Johnson doctrine of flexible response, which asserted that the United States needed a wide range of weapons and forces to deal with a spectrum of military contingencies. Both strategic and tactical nuclear weapons remained an important part of America's defenses, but the nation faced a changed strategic situation. In the late 1960s and early 1970s, the Soviet Union achieved substantial, if not complete, parity with the United States in strategic nuclear weapons, and the Nixon doctrine of strategic sufficiency implicitly recognized the new balance. In order to prevent an arms race, the two great powers began strategic arms limitations talks (SALT) in late 1969, and after arduous negotiations, signed a series of agreements in 1972. These agreements limited the deployment of antiballistic missiles and placed interim ceilings on land- and sea-based nuclear delivery systems. Although the SALT talks were far from complete in 1972, the United States and the Soviet Union had at least begun a process that many hoped would lead to firm controls on strategic nuclear weapons.[4]

After the support it provided to the Army during the SALT negotiations, ESSG did substantially less work on offensive strategic weapons than it had done in the previous two decades. Except for a study of atomic demolition munition (ADM) deployment completed in 1970, ESSG's studies on offensive weapons concerned theater nuclear weapons employment in Europe. ESSG, like the Army, turned with renewed interest to the prospects of a war in Europe. The remainder of the group's study of nuclear weapons was devoted to the effects of nuclear attacks on the United States as ESSG continued the extensive work on nuclear weapons effects that had flourished during the previous decade. Although the studies of nuclear weapons accounted for almost one-sixth of the ESSG studies from 1970 through 1975, this proportion was substantially lower than it had been in the previous decade, and after 1975 the group conducted only one more nuclear study. In the early 1970s the ESSG's long involvement in the field of nuclear weapons virtually ended.

The nuclear weapons with which ESSG was involved the longest were ADMs. Since the early 1950s the group had studied the use of ADMs in barrier operations. One objective in this work had been to identify appropriate targets. In a study released in June 1970, the group developed a procedure for determining both the targets and the requirements for ADMs in any particular theater.[5] The study developed criteria for measuring the delay that the destruction of certain fixed targets—tunnels, roads, and bridges—would cause enemy tracked vehicles and dismounted infantry. After estimating the degree of destruction required, the procedure considered nuclear safety restraints, the amount of time and materiel involved in emplacing ADMs, and the probability of detonating the device and

achieving the desired destruction. These factors were calculated on a computer and the result was a list of appropriate targets, which also served as an estimate of the number of ADMs that a theater would need. The procedure provided a reasonable estimate of the role that ADMs could play in a tactical nuclear war.

In January 1973 the group turned its attention to examining targeting roles for theater nuclear delivery forces.[6] Included in the analysis were delivery systems (missiles and bombers) under the control of the Supreme Allied Commander, Europe (SACEUR) and those under the control of other commands. ESSG's concern in this study, as in earlier ones, was the role that nuclear weapons could play in halting a Warsaw Pact land invasion of NATO. The group identified a series of target that could hinder Warsaw Pact ground and air operations and then calculated which delivery systems were best suited for destroying the targets.

In a study published later in 1973, the group continued its analysis of theater forces by examining the actual nuclear plans of selected theater and strategic nuclear forces.[7] Although the methods were more sophisticated, the subject of the study and some of its conclusions closely resembled the analyses of the atomic annexes in the 1950s. As it had done in the studies of the annexes, the group pointed out targeting problem areas that were present in the plans. While the flaws in the strike plans were not as extensive as they had been in earlier decades, ESSG continued to criticize the plans for failing to sufficiently notice targets that could have a direct bearing on the land battle in Europe. In order to remedy this deficiency, the group recommended alternative targeting designed to increase the overall effectiveness of the plans.

In a further examination of theater nuclear weapons in 1975, the group studied the terrain along the border of the NATO Central Region in order to determine how terrain features would influence Warsaw Pact deployment of forces and avenues of attacks.[8] The study then considered three NATO nuclear responses ranging from restricted to general use of nuclear weapons and calculated the number of nuclear weapons required for each of these three options. In this study as in the other two, ESSG was concerned with the effect of theater nuclear forces on the land battle that the Army would be primarily responsible for waging. Throughout the more than two decades of its work in nuclear targeting, ESSG had tried to assure that the Army's concerns were considered in strategic and theater nuclear planning.

In the early 1970s the group also continued investigating the vulnerability of the United States to strategic nuclear attack. *The United States in 1982* (US-82), published in 1970, was a substudy of the larger Department of the Army inquiry into "U.S. Strategic Forces Options for 1972–82."[9] In many ways US-82 was reminiscent of PAMUSA-63 and PAVUS-75 because it had as its purpose "to project the growth of the

United States to 1982 and to identify the strategic implications of this growth."[10] The group drew much of the data for US-82 from a study published earlier in 1970: *Long Range Army Stationing.*[11] The study predicted that the American population would grow from 204 million to 243 million, but that the labor force would increase at a more rapid rate from 85 million to 102 million: "The labor force is increasing faster than the population because women continue to enter the active market—a trend started during World War II. An analysis of this demographic growth indicates that both the population and labor force are migrating to the south and west and are concentrating in urban areas nationwide."[12] Three years earlier, in PAVUS-75, ESSG had already identified the trend of population movement to the Sun Belt, and in 1970 it predicted that industry would also continue to move into this region. The most disturbing aspect of these shifts in population and industry was the tendency toward concentration in urban areas, which increased "the strategic vulnerability of the economy."[13] (See figure 27.)

The concentration of population in urban areas could also endanger the post-attack recovery of the nation. Of all the occupational groups in society, management was "considered by many authorities to be the most critically required occupation in the post-attack environment. Management is becoming highly concentrated in our largest urban areas and therefore is particularly vulnerable to nuclear attack."[14] (See figure 28.) The movement of industry and population, especially key occupational groups, into cities brought economic advantages but also created strategic liabilities.

While the migration of population and industry would produce important changes in the United States, the group felt that "the greatest impact on society by 1982 will be computer technology."[15] Like most forecasters prior to 1973, ESSG analysts did not predict the resistance to nuclear energy or the rapid increase in the price of foreign oil. The study maintained that "nuclear energy will be used much more widely for generating electricity" and that the importing of foreign oil would continue at high levels because it would be cheaper than extracting oil from the shale deposits in the West.[16] According to ESSG, however, the United States would still have large surpluses of food and would be the largest producer and exporter of food in the world. Although the study predicted that the country would remain the world's largest economic power, much of its growth would be in services rather than in basic industries, and the gap in industry between America and its closest competitors would narrow. While US-82 did not predict all the important changes that would affect the country, it did isolate some of the potential dangers that the United States would face in a nuclear war.

In addition to these broad estimates of the vulnerability of the United States, the Army also needed more detailed and concrete plans for dealing with the chaotic conditions that would result from a nuclear assault

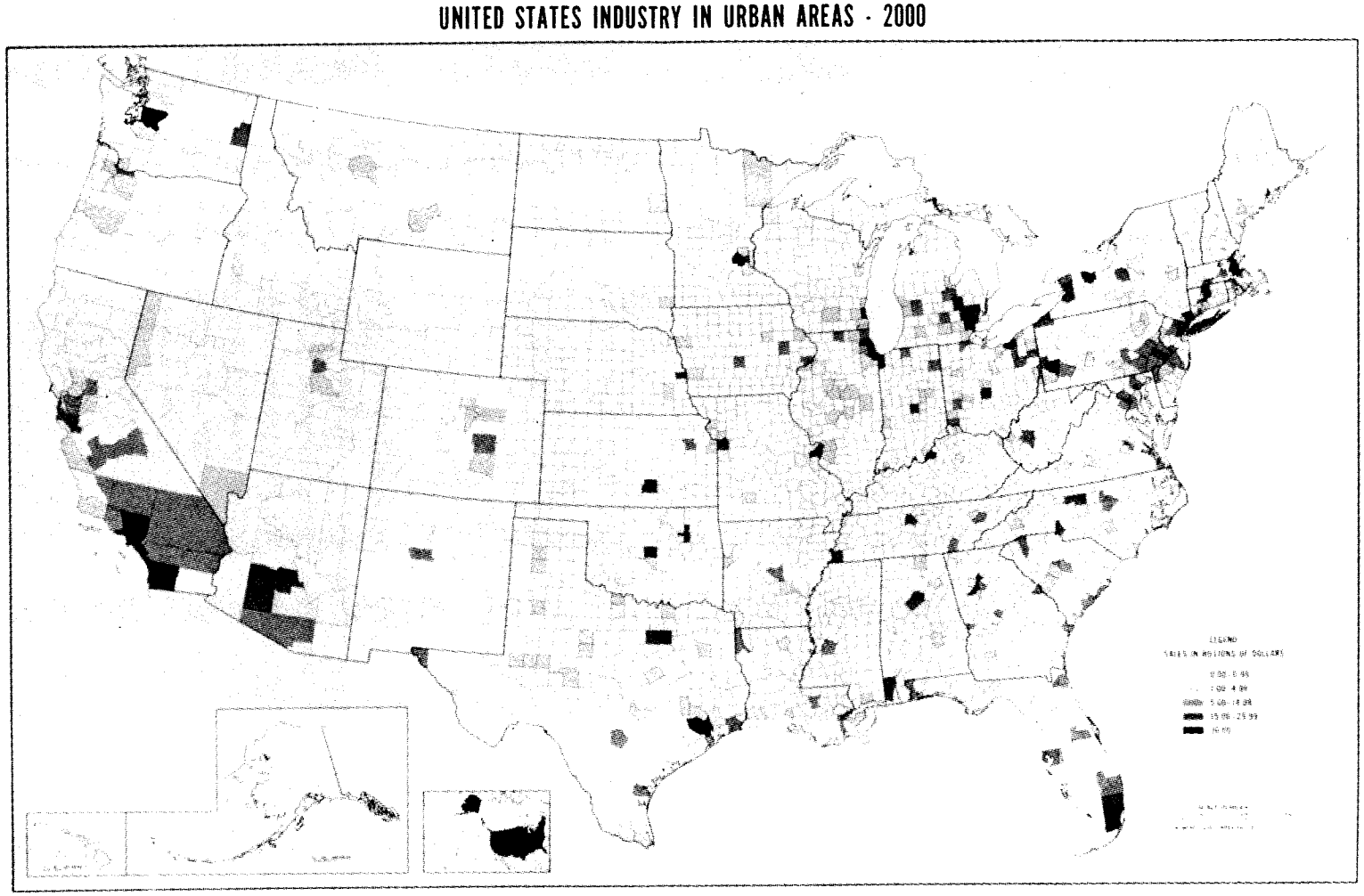


Figure 27

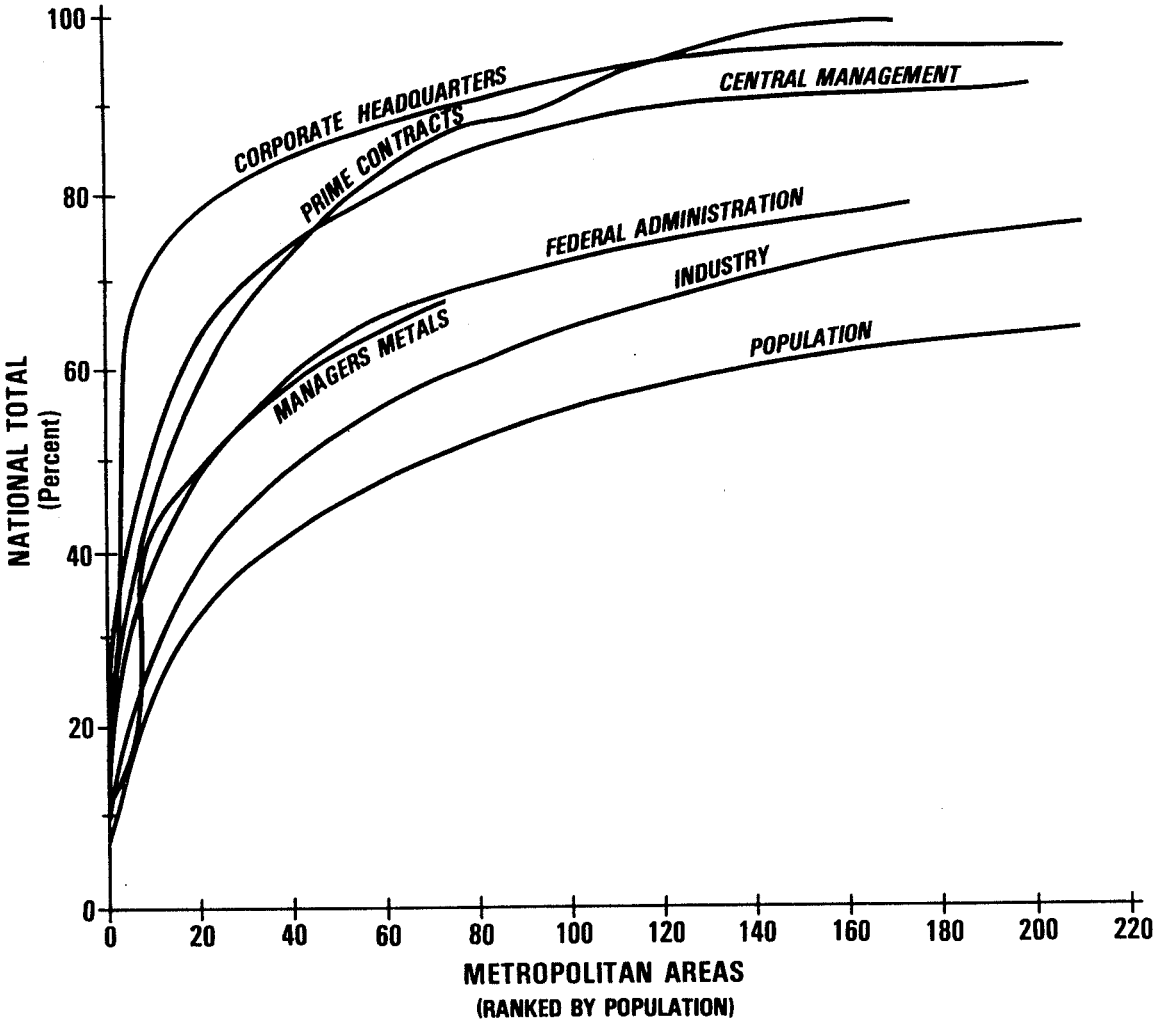


Figure 28

on the nation. In 1969 the Chief of Staff of the Army asked ESSG to determine "the most effective means of providing military damage assessment information to the Army Staff during the period immediately following the start of a general nuclear war."[17] The group devised a procedure, called Military Damage Assessment, which provided "an indirect estimation followed by a direct assessment of damage and casualties resulting from an attack on the United States and the resulting military residual capability."[18] The Chief of Staff Regulation No. 500-2, dated 9 May 1970, embodied most of ESSG's recommendations and initiated the Army Damage Assessment System (ARMDAS). Because the Army staff expected that the system would require ten years for full development and implementation, it asked the group to provide technical assistance and to draw up interim procedures that could be used until ARMDAS was completed.[19]

The basic problem that ARMDAS addressed was the lack of information immediately following a nuclear attack, when the Joint Chiefs of Staff and Army headquarters would, according to ESSG, "require information on residual military forces and supporting resources in order to reach decisions and develop plans for the employment of forces and the allocation of supporting resources. However, the effects of a nuclear attack will, in all probability, prevent the collection of required information on a timely and accurate basis."[20] During the first few hours after an attack, ARMDAS would base its estimates of damage on computerized projections that the Army had programmed prior to the attack. These estimates of the enemy's most likely attacks would then be gradually supplemented by actual damage data that civil defense and other authorities would feed into the system. The actual damage information would be used to revise and update the computer estimates in order to determine the survival rates for installations, facilities, materiel, and personnel. These estimates, which would become increasingly accurate as data accumulated, would be used by the Army staff and the JCS to devise and implement a military response. ARMDAS would provide military authorities with information throughout a nuclear attack and allow them to begin planning prior to receiving complete and perhaps long-delayed reports on the full extent of the nuclear damage.[21]

The Army wanted ARMDAS in its final form to contain very extensive data on national military and socioeconomic conditions as well as on nuclear weapons effects. Processing this information required new computer programs and new hardware. Because implementing the system would require considerable time, the staff in 1970 asked ESSG to draft a handbook of interim operational procedures, and this manual was updated and revised in 1973 and 1974.[22] ARMDAS allowed the Army to prepare for the enormous confusion that would accompany a nuclear attack on the United States.

As a result of its work on ARMDAS, the Deputy Chief of Staff for Operations (DCSOPS) asked ESSG in 1971 to support Army participation in the second JCS Post Nuclear Attack Survival Study (PONAST II). While providing data for PONAST II, the group discovered that its estimates of the survival of Army personnel after an attack were much higher than the JCS committee's projections.[23] An investigation of the discrepancy showed that "the Army system uses actual data on building hardness and radiation protection factors, while the PONAST method relies on constant factors which were lower than worst case actual conditions."[24] During the previous year, ESSG had already estimated the survival rates of Army reserve units from a nuclear attack and had supplied the Army staff with the number and types of units that would probably be available or could be reconstituted after the attack.[25] Thus, in the early 1970s, ESSG continued its work on both the methodological and substantive problems involved in estimating the effects of a nuclear attack.

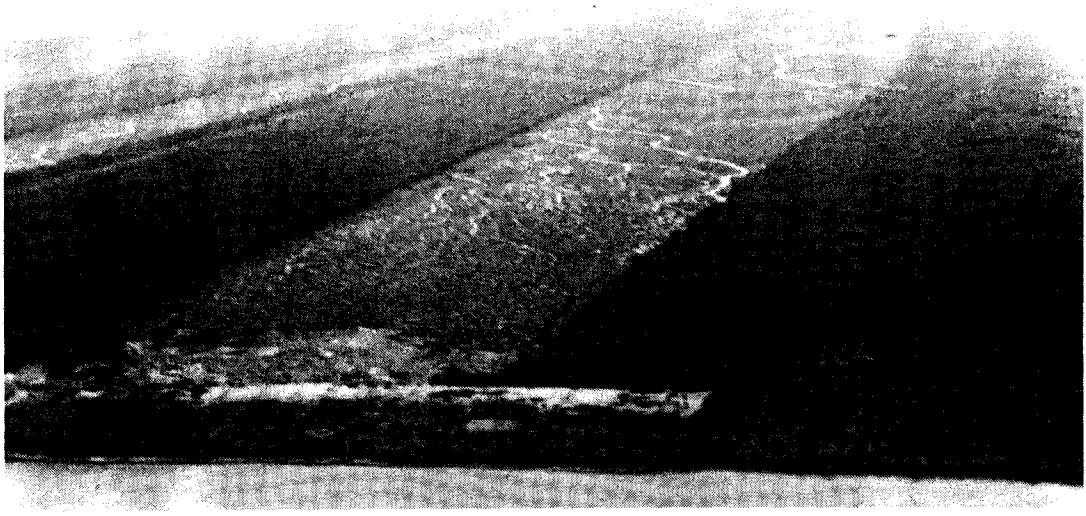
While the group's studies of the early 1970s no longer covered the broad strategic nuclear topics that they had addressed in the previous two decades, the organization continued to work on theater and tactical nuclear weapons and vulnerability problems. As the procedures for programming strategic weapons had become more standardized and automated, the major flaws in the atomic annexes of the 1950s had been largely corrected. However, the Army was still concerned that strategic and theater strike plans should be formulated so that they contributed to winning the land battle in Europe. Although concern with the McNamara goal of damage limitation had declined, the Army was still preparing for the eventuality of a first strike against the United States. In its studies in both of these areas, ESSG drew upon two decades of work in the nuclear field and provided the Army staff with the support it required.

* * *

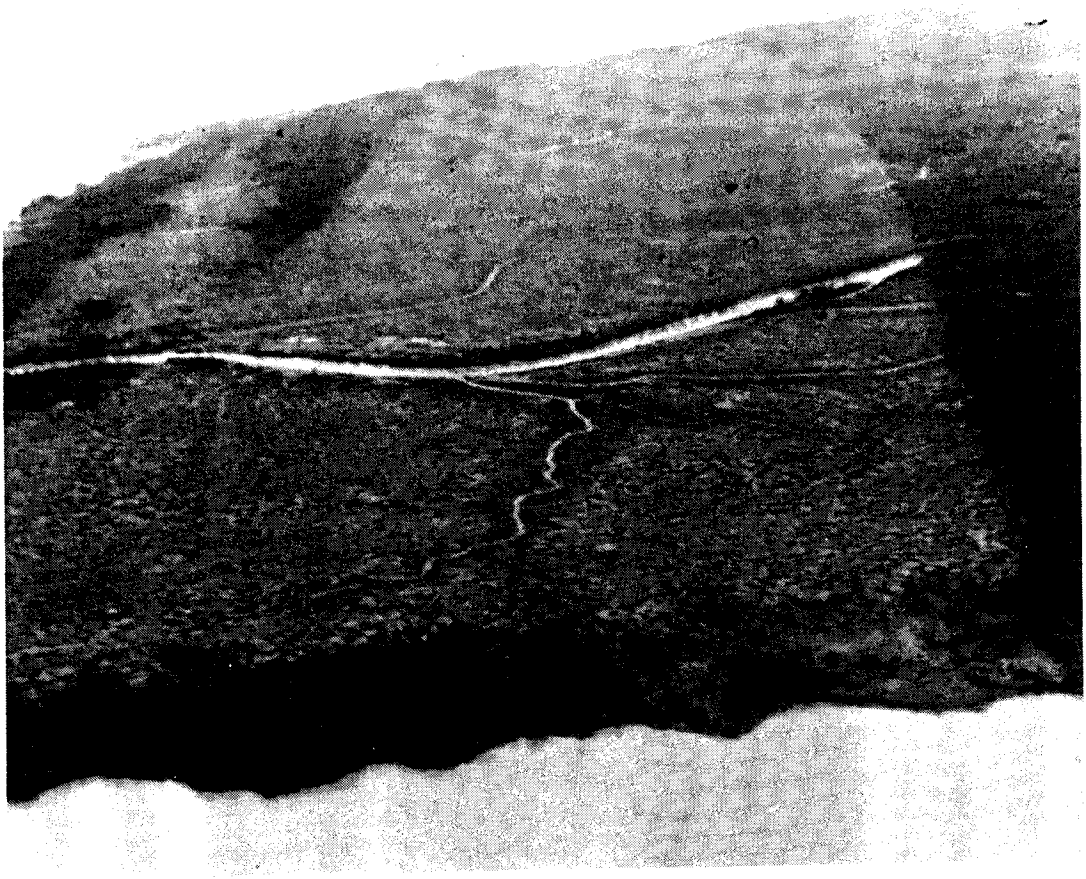
Although the Army was still preoccupied with the Vietnam War in 1970, ESSG did much less work regarding the war than it had in the late 1960s and the nature of its work on Southeast Asia was quite different. In its studies during the early 1970s, ESSG concentrated on assimilating the lessons learned from the conflict and applying them to future situations. Because Southeast Asia did not have the same significance for the future, planning agencies like ESSG turned toward topics and areas that appeared more salient for the 1970s and 1980s. Nevertheless, Vietnam could not be ignored, especially as the debate over the war grew more heated.

One controversial issue relating to the war in Vietnam was the use of herbicides as defoliants and destroyers of vegetation (see figure 29). The American military had begun testing herbicides in 1961, but the program of spraying the chemicals from aircraft reached its height in 1967 and 1968. Spraying continued at a reduced rate until April 1970 when use of the most controversial herbicide, Agent Orange, was halted. By May 1971, all aerial spraying had stopped.[26] In October 1970, however, Congress had ordered the Secretary of Defense, Melvin R. Laird, to commission the National Academy of Science to conduct a review of the herbicide program. In addition, the director of Defense Research and Engineering in the Office of the Secretary of Defense requested that ESSG study the military effects of herbicides.[27]

The group's study, *Herbicides and Military Operations*, published in 1972, sought "to determine the military effects of chemical herbicides used in support of military operations."[28] Based on an analysis of data about the use of herbicides in Vietnam, ESSG evaluated their effectiveness in Southeast Asia and projected possible military uses in future conflicts. Three principal sources of information for the study were a survey of more



Defoliated And Nondefoliated Strips



Defoliated Area With Some Regeneration

Figure 29

than 500 officers who had served in command or advisory positions in Vietnam in the late 1960s, several reviews and analyses of the herbicide program that had been conducted by other government and private organizations (including a Rand study), and computerized records of military engagements and fixed-wing spraying missions in Vietnam provided by the National Military Command System Support Center.[29] ESSG conducted no new laboratory or field experiments.[30] The data for the study and its scope were restricted to military sources and military effects.

In its survey, ESSG asked officers from all three services simple and straightforward questions about their own evaluation of the effectiveness of herbicides. The majority of the officers responded that defoliation had assisted in the performance of their mission and had greatly improved the ability to see. They maintained that the use of herbicides around fixed base camps and along communications routes had significantly assisted in defending the bases and reducing American casualties. Most of the officers felt that enemy casualties had been only slightly increased by defoliation. In their responses to questions about the program to spray and destroy the enemy's food crops, most officers said that the spraying had helped the South Vietnamese government both militarily and politically and that the program had usually been reliable in distinguishing between crops grown for the enemy and crops grown by noncombatants. Although the responses to the questions were not unanimous, the officers generally felt that the herbicide program had been effective.[31]

ESSG's review of the earlier and generally classified analyses of the herbicide program concluded that these studies "confirmed the improved visibility from herbicides, the ability to disrupt enemy operations in remote areas, and the technical adequacy of herbicide distribution techniques."[32] Although the officers surveyed had felt that the destruction of crops had helped the South Vietnamese government, the earlier studies indicated that "the unfavorable reaction of non-combatants worked against the Government of Vietnam's effort to extend its influence and support among the rural population."[33] The conclusions of the earlier studies ran counter to the survey results in certain areas.

Finally, the ESSG study attempted to correlate the numerical data on military engagements in South Vietnam with data on herbicide spraying from aircraft. Although the National Military Command System Support Center had provided much information, the results of ESSG's analysis were not decisive: "The conclusion is that significant net changes occurred after spraying. But the evidence is not sufficient to attribute the net changes to direct or indirect effects of herbicides delivered from fixed wing aircraft. In general, other military programs were also underway and may deserve all or part credit for net improvements over time."[34] The data did not allow ESSG to isolate clearly the military effects of spraying.

In its own summary of the effect of herbicides on military operations in Vietnam, ESSG concluded that they "contributed to area denial programs when observation and surveillance were maintained in the treated areas," and "to friendly operations to counter ambush threats near roads and waterways and to secure fixed installations."[35] In addition, their use led to "some economy of friendly forces in treated areas."[36] The study was less favorable in its analysis of the spraying of enemy food crops: "Herbicides destroyed enemy crops, but the enemy was able to compensate and overcome localized food supply shortages. At most, the crop destruction program harassed the enemy."[37] In ESSG's opinion, the specifically military effects of the herbicide program were difficult to isolate:

> The ultimate objective of the herbicide program has been the same as that of most other military programs, to neutralize enemy forces or some of their capabilities. In this sense, the enemy was always the only real target of herbicides; vegetation was always only incidental. Yet most of the available record is a description of incidentals. Unfortunately, the herbicide program has been measured most in terms of itself, vegetation, and the reactions of friendly forces rather than in direct reference to the enemy, what he wanted to do, and what he actually did.[38]

Some of the ambiguity about the effects of herbicides arose, therefore, because of the confusion of the effects on vegetation and the effects on military operations: "Herbicides in a strict sense have direct effects only on vegetation. All military effects, apart from the destruction of food crops, must be indirect. Herbicides affect vegetation in a way that improves visibility and can create military opportunities, but unless these opportunities are exploited, there generally cannot be a military effect."[39]

If, as the study maintained, "foliage is never the enemy,"[40] why did the officers surveyed have such a positive impression of the results of spraying? ESSG concluded that "some psychological reaction"[41] was involved that could not be gauged by a questionnaire: "A partly psychological interpretation of survey results indicates that the officers agree that visibility was improved in many circumstances, regard the improved visibility as beneficial, but make little or no association between improved visibility and specific events."[42] Much of the officers' favorable impressions of herbicide effectiveness probably came from "an accumulation of confidence in being able to see better whether or not there is anything more to see."[43]

In spite of the complexity and ambiguity of the Vietnam experience, the study attempted to provide some general guidelines for future uses of herbicides in military operations:

> Where an enemy relies on foliage to achieve concealment, stealth, and deception, herbicides can be a contributing factor in disrupting or dislocating enemy operations. The net effect depends on time, alternatives open to the enemy, the enemy's determination, and the extent to which friendly forces exploit

> the opportunities created by herbicides. Herbicides can be useful as a support to military operations provided that special circumstances exist.[44]

The military utility of herbicides depended heavily on a variety of factors, including the initiative shown by American forces.

The herbicide study was ESSG's only major classified document leaked to the press. The publisher of *Science and Government Report*, Daniel S. Greenberg, first obtained the ESSG report, including the third volume (classified as Secret), and wrote that the volumes were "unstinting in their endorsement of herbicides."[45] Another article published in *Science*, the journal of the American Association for the Advancement of Science, stated that the ESSG study had "concluded that herbicides were of only limited usefulness in the Vietnam war and, in effect, damns them with faint praise."[46] The article in *Science* characterized ESSG as "a type of in-house think tank that, according to a variety of officials, has a high reputation for objectivity in the sometimes-warring factions of the Pentagon."[47] According to *Science*, the conflict in the Department of Defense was between the Joint Chiefs of Staff, who favored the use of herbicides, and the Office of the Secretary of Defense (OSD), which opposed it.[48] An unnamed official was quoted in the *Science* article: "I remember being surprised that this was handed to ESSG and not to Systems Analysis. But possibly that was because Systems Analysis had already established a track record of taking a dim view of it."[49] Another official cited in the article took a different view:

> An official who was involved in the genesis of the report explained why ESSG was chosen. "Systems Analysis really doesn't do that sort of thing. Weapons Systems Evaluations Group might have done it. ESSG was chosen because of the large background of information they had of the geology, climatology, and flora of the area. They have made a number of very good surveys of the country so they would understand the problem, and they could also look into the war-gaming type of problems."[50]

Whatever the reasons for the selection of ESSG to do the study, it was soon caught up in the "warring factions" not only within the Pentagon but also outside of it.

Although the journal articles in *Science* and *Science and Government Report* criticized ESSG's endorsement—weak or strong—of herbicides, they focused much of their attention on the opinion surveys of the officers. *Science and Government Report* commented that the survey "produced a generally favorable response concerning the military utility of herbicides, but the favorable responses were far from overwhelming, and in most cases, a small percentage of the officers concluded that defoliation actually worked to the tactical and political advantage of opposing forces."[51] The *Science* article singled out the survey question that asked if herbicides

were needed in future conflicts (see figure 30). According to *Science*, the officers responded with "an extraordinarily large number of 'no' and 'perhaps' replies," indicating, according to Congressman Les Aspin (D-Wisc.), "grave doubts concerning the effectiveness of defoliants."[52] ESSG's survey did show that Air Force and Marine Air officers were decidedly less enthusiastic about herbicides than were officers of the Chemical Corps, in whose province the defoliants lay. The survey results, like the conclusions of the ESSG study itself, were open to a variety of interpretations.

FUTURE NEED FOR HERBICIDES

	Yes	Perhaps	No
Army Chemical Officers	28	5	0
Army and Marine Commanders and Advisors	238	83	20
Air Force and Marine Air	145	116	38
Navy	107	35	9
Total Respondents	518	239	67

Figure 30

Even more controversial than ESSG's evaluation of herbicide use in Vietnam was the group's "recommendation"[53] that herbicides be used in future conflicts. In order to test the utility of herbicides, the study recomputed the outcomes of five SPECTRUM scenarios adding the effects of defoliants. The discovery of the then-Secret SPECTRUM scenario prompted some harsh criticism from Representative Aspin: "Everyone understands the need for contingency planning by the Army but if the allegations reported in *Science and Government* [Report] are correct, the study sounds like a flight of fancy right out of Dr. Strangelove; a real nightmare of computer lunacy."[54] The Department of Defense responded that "the SPECTRUM scenarios are completely hypothetical computer models of various warfare situations and have nothing to do with existing battle plans or contingency plans."[55] Nevertheless, the revelation in 1972 that the Army was even considering hypothetical counterinsurgency situations in places like Venezuela and Ethiopia provoked outcries.

According to an article in the *Washington Post*, the classified third volume of the ESSG study concluded that "offensive forces in Venezuela

are reduced to approximately 40 percent of the forces required in the original SPECTRUM analysis and offensive forces in Ethiopia are reduced to approximately 35 percent of those needed without herbicides."[56] The ESSG study itself called the figures tentative because they were based on one particular model of counterinsurgency warfare. Thus, "because no theory of counterinsurgency is highly developed or widely accepted, theoretical predictions have not been declared official estimates nor have they had great impact on military programming."[57] Similar SPECTRUM analyses of conventional war situations, including a war in Europe, revealed that herbicide use would probably have little or no effect on these military operations. In the final analysis, the public debate over ESSG's herbicide study probably revealed more about the atmosphere of tension and distrust in American society at the end of the war in Vietnam than it did about the role of herbicides in war.

Although ESSG was not asked to study the environmental and ecological effects of herbicides, in 1973 it was asked to examine the environmental effect of Rome plow operations in Vietnam. The Rome plow, manufactured in Rome, Georgia, was a large blade that was attached to a heavy track-type tractor. Engineer troops used these plows to clear away vegetation, including large trees, from the same sorts of areas that were sprayed with defoliants. The Engineers first tested the plow in Vietnam in August 1966 and used it extensively until December 1971.[58] In order to determine the environmental impact, ESSG used records from units stationed in Vietnam, interviews with former commanders in Southeast Asia, and sequential aerial photographs. Although the evidence was not as complete as the group would have liked, the study concluded "that Rome plowing operations left no significant lasting effects on the environment except as it sets back the size and age of vegetation on a particular site."[59] Regrowth of essentially the same type of vegetation was swift, but obviously trees would take a number of years to return to their original size. Erosion was also "not a significant problem."[60] On the other hand, use of the land for other than its original purposes, especially farming and gardening, was rare as well. According to the study, the impact on the environment was "very slight."[61]

While the studies of both herbicides and Rome plow operations had attempted to evaluate the lessons of these operations in Vietnam, the final years of the war in Southeast Asia led ESSG to return to another topic that looked more toward the future. The problem of controlling the infiltration of men and supplies from the north into South Vietnam continued to bedevil American officials:

> Past efforts to control infiltration by land into SVN [South Vietnam] have been largely unsuccessful. Major reasons for this failure are the large amount of facilities and land forces required to establish and maintain an effective control system

> along a border 1,700 kilometers (1,070 miles) in length. Efforts to halt infiltration by air interdiction (assisted by sensors) have harassed the enemy and caused casualties, but have not stopped deployment and support of increasingly large forces. Past ground operations that interdict enemy land LOC and destroy supplies in base areas outside SVN have not stopped infiltration over the long term.[62]

In March 1971, ESSG published a study that evaluated the effectiveness of sensing devices designed to betray the movements of infiltrators.[63] Based on evidence obtained from six American divisions stationed in Vietnam during 1970, the study compared the effectiveness of 14 "surveillance systems," including such sources as sensors, aerial photography, aircraft scouting, captured enemy documents, and prisoner of war interviews. Although the evidence was not conclusive, ESSG found that American intelligence officers rated ground sensors highly. On the other hand, the study reported that "there is no evidence of great enemy concern about them."[64] The nature of the data collected in Vietnam and the wide variety of "surveillance systems" made arriving at decisive conclusions difficult.

At the end of 1972, ESSG published a more extensive study that proposed one system to monitor infiltration and another to control it. The monitoring system would provide a means for some neutral group to gain reasonably reliable information on the existence and extent of infiltration. The system consisted of two fences that would be patrolled by forces whose mission was simply to verify infiltration attempts. The control system proposed was a series of strong points to serve as observation posts and bases against infiltration by small groups. A large mobile force would operate as a reserve to block larger incursions. While the 1966 system proposed by ESSG had relied heavily on fences, ditches, and other obstacles, the 1972 system relied less on a formidable barrier and more on a mobile reserve force.[65] The study assumed that monitoring would be done by an international force with control in the hands of the South Vietnamese. That the ESSG studies of infiltration control came near the beginning and the end of America's involvement in Vietnam was simply another indication of the persistence of the problem. That no effective control system was ever implemented was vividly demonstrated by the final North Vietnamese offensive of 1975.

The ESSG studies of herbicides, Rome plow operations, and infiltration clearly grew out of the war in Vietnam. The examinations of herbicides and Rome plow activities were historical analyses of Army experiences in Southeast Asia done to serve as possible lessons for future military operations. The infiltration monitoring and control studies once again tackled a persistent problem that plagued American armed forces throughout the war and threatened to continue even after their withdrawal. Although the ESSG studies relating to Vietnam were far removed from the current military operations in Southeast Asia, they were still controversial.

The leaked herbicide study placed the group momentarily in the public spotlight. Although no other studies of the early 1970s attracted such media attention, some received attention beyond the confines of the Defense Department.

* * *

Early in 1971 ESSG began work on a new subject related to the ongoing struggle in Southeast Asia as well as to problems plaguing civilian society in the United States. As in the case of atomic weapons studies in the early 1950s, there was no direct precedent for this work in the organization's history. However, the group's previous work in related areas and its reputation for undertaking new and unusual projects propelled it into the unlikely field of drug abuse.

In January 1971, DCSOPS asked ESSG "to maintain sufficient knowledge of changing world conditions in order to provide input to the Army Staff."[66] The group had already accumulated substantial experience and data as a result of its vulnerability studies, such as PAMUSA and PAVUS-75, and its analyses of long-range Army stationing. Early in the process of responding to this directive, ESSG decided that it should concentrate on "critical elements of change rather than on an across-the-board data base of statistical information."[67] Analysts from the group met with the director of Army Studies, Office of the Assistant Vice Chief of Staff of the Army, in March 1971 and decided that drug abuse was an area that deserved immediate and intensive study.

According to former Technical Director George Orrell, ESSG's leadership felt that the group's analysts were able and willing to expand into an uncharted area.[68] The recognition by civilian and military authorities that drug abuse had become a critical problem provided additional incentive for the group to undertake studies on the subject. During the late 1960s growing evidence revealed that drug abuse was reaching what some considered to be epidemic proportions in both military and civilian life, particularly among young people. The abundance of cheap drugs in Southeast Asia and the growing disenchantment of American young people helped create a mood that resulted in steadily rising levels of drug use and abuse.[69]

The Army considered the problem so important that it established the Directorate of Discipline and Drug Policies in the Office of the Deputy Chief of Staff for Personnel (DCSPER) in the summer of 1971. ESSG briefed the new director in June and he assumed official sponsorship of the group's continuing effort. Serving as a consultant to the drug abuse directorate, ESSG helped prepare for the Army World-Wide Conference on Drug Abuse held in September 1971. The group prepared a multi-media keynote presentation for the conference and wrote a critique of its proceedings. The presentation was so well received that ESSG repeated it at

several regional Army drug abuse conferences.[70] Finally, in May 1972, the group published its analyses in the widely distributed study, *A Profile of Drug Abuse in the United States.*

As the titled implied, the study was limited to the civilian sector because Army officials and ESSG felt that there was a "lack of a definitive overview study of the extent of drug abuse in the United States."[71] Although the study did not imply that drug abuse was peculiar to civilian society or that civilian society had "infected" the Army with the problem, there was an impression that drug abuse among young soldiers in Vietnam was related to that among young American civilians at home: "This study develops a profile of the national drug problem in the United States so that the Army will have a more complete understanding of and a better perspective on drug abuse within the nation as a whole and its relationship with the Army."[72] In order to provide this understanding, the study examined various statistical surveys of drug abuse patterns, discussed reasons for abuse, reported on what the nation was doing about abuse, and provided some of the group's perspectives on the problem in general. ESSG based its analyses on research in the literature on the drug problem, statistical surveys performed by other organizations in the Washington area, and its own survey of 86 major drug abuse treatment centers throughout the country.[73]

Although many polls had surveyed drug use, ESSG considered their coverage uneven and their statistical validity at times suspect. Of the surveys and polls considered statistically correct, most dealt with high school and college youths, who were easily polled, and most showed that drug use in these groups had steadily increased with no indications that it would level off in the near future. This conclusion applied primarily to marijuana use because less data on heroin and other narcotics was available. All evidence indicated that drug use was heaviest among young people.[74]

Although the reasons for drug abuse were complex and intertwined, the study cited a number most commonly encountered.[75] (See figure 31.) Since usage was primarily a phenomenon of the youth culture, peer group pressure played a significant role. But according to ESSG, the entire society was in many ways drug-oriented: "There is widespread cultural acceptance of the use of intoxicants and psychoactive drugs in American society."[76] The study placed particular blame on the drug manufacturing industry and the medical profession, which produced and prescribed drugs in huge quantities. The social and peer pressures leading to drug abuse were accompanied by individual motivations, including curiosity, boredom, stress and tension, and feelings of inadequacy and lack of self-esteem. Drugs provided a sense of escape from complex and frightening problems: "Drug abuse and the values connected with the drug subculture represent alternatives to young people in search of meaning in a world in which they feel alienated and alone."[77] Some also felt that drugs increased creativity, offered sexual liberation, or assisted in providing mystical or religious experiences.

REASONS FOR ABUSE

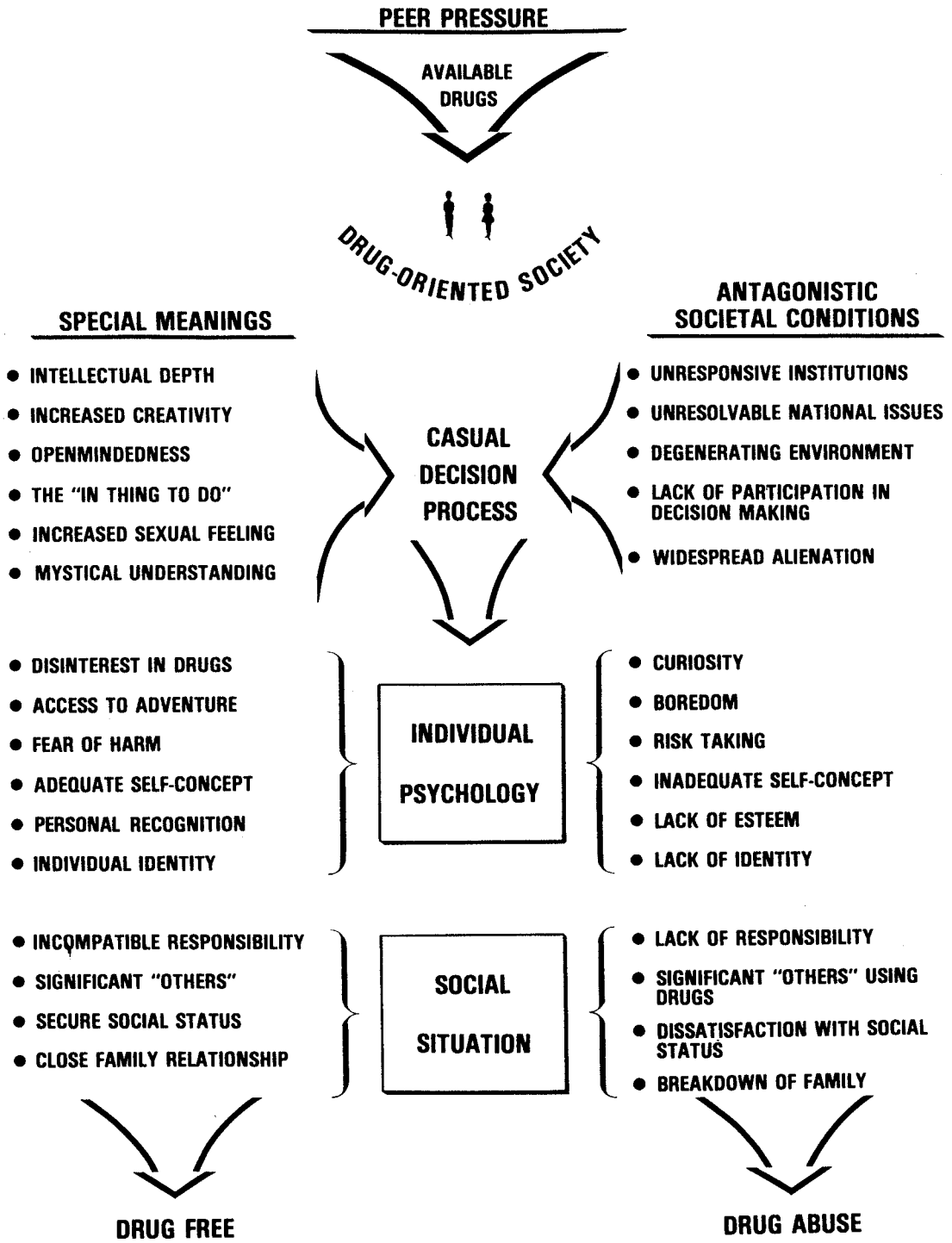


Figure 31

Whatever the various motivations of a particular individual, the study stressed that the decision to use drugs was not rational and that it was not made once but many times throughout a person's life.

In its survey of what the nation was doing about drug abuse, ESSG provided some of its thoughts about how to deal with the problem. Although the Controlled Substances Act of 1970 had codified and standardized federal drug laws, a wide variety of state and local statutes remained, many of which were excessively punitive: "Because of outdated and unrealistic laws, law enforcement of drug abuse as practiced in many parts of the nation today adds to our problems by causing less respect for authority and the law."[78] According to the study, the penalties for drug use should be made more reasonable and consistent. The threat of legal sanctions, however, was not sufficient; young people needed to be educated about drug use. Because, in the group's opinion, the home and the church had abdicated responsibility for drug education, the burden had fallen on the schools, which were unprepared for the task. The educators surveyed by ESSG agreed that scare tactics seldom worked, that scientific facts convincing to adults often failed to persuade young people, and that short educational programs were rarely effective. Educational programs needed to be credible to the young and they needed to start early and continue throughout life.[79] "Drug abuse cannot be expected to decrease until people are taught how to deal effectively with the problems of living in a modern society and understand that drug abuse is a symptom of one's inability to meet those complexities with confidence."[80]

Not only were the traditional institutions of home, church, and school failing to deal with the drug problem, but the new drug rehabilitation programs were also failing. The survey of rehabilitation programs showed a very low number of successful cures. According to the study, however, "not the least of the problems concerned with rehabilitation, is that standards for measuring success are not realistic."[81] Most programs aimed at producing a person who was totally drug-free for life after his or her treatment, but ESSG concluded that a less stringent standard was more appropriate: "Rehabilitation should be directed toward returning an individual to productive life in society—whether or not he remains drug free. If the nation's populace and officials can accept this more realistic goal, rehabilitation should be able to do the job that is required."[82]

Although the study was pessimistic about the progress of law enforcement, education, and rehabilitation toward solving the problem of drug abuse, it maintained that a solution was critically important: "The nation is experiencing a social revolution among a significant number of a population group that will be playing a major role in directing the course of national events in the near and long-range future."[83] Even though the existing solutions had failed, the situation was not hopeless: "It appears, therefore, that attempts to eliminate drug abuse from the national scene will

continue to be unattainable. What does appear attainable is toleration and control of drug abuse within some limits. This may require changing the attitudes of many Americans including many officials."[84] Ultimately, a solution to the problem of drug abuse required changes not only in the attitudes of people who were using drugs but also in the attitudes of the majority who were not.

After the publication of the drug abuse study in 1972, ESSG continued its work on the problem. The group served as a consultant to the drug abuse directorate in DCSPER and made recommendations about Army drug prevention and control programs. In mid-1972, however, ESSG's work in drug abuse took an unexpected though logical turn. During the early 1970s, the federal government launched extensive drug abuse treatment programs, which by FY 74 had a budget of almost $200 million. In the first few years of the effort, the emphasis was on rapidly expanding the community-based treatment and rehabilitation programs and providing money quickly to areas with large abuse problems. By 1972 it appeared that the rapid expansion of the program had ended, and now the National Institute of Mental Health (NIMH), which administered much of the federal money, needed to consolidate and evaluate the programs that had been established.[85] "In mid-1972, NIMH began exploring ways to develop an analytical approach to the integration of data on all its community-based treatment and rehabilitation programs. It was hoped that such an analytical approach would assist managers in making sound decisions in the planning, programming, and budgeting for treatment and rehabilitation activities."[86] In 1974 the responsibility for drug treatment at the federal level shifted from NIMH to the newly established National Institute of Drug Abuse (NIDA), which placed more emphasis on increasing the effectiveness and efficiency of the services that programs provided to drug abusers.

As a result of this change in emphasis, NIMH and then NIDA turned to ESSG for assistance. The group developed a model and drew up a series of computer programs called NIDALP, which were designed to help NIDA in "creating an efficient system of service delivery" to drug abusers and in "demonstrating the effectiveness [of drug abuse programs] in reaching objectives" defined by NIDA.[87] ESSG hoped that the availability of NIDALP to the entire treatment community would assist NIDA and the various treatment programs in evaluating their performance, adapting their programs to changing needs and conditions, and achieving the most efficient and effective use of their resources.[88]

The early 1970s were a difficult period of transition for the Army. Caught in an avalanche of criticism growing out of the war in Southeast Asia, the Army also faced internal problems, such as drug abuse, that related to the war and changing values in American society. The transition from a conscript to an all-volunteer Army heightened the importance of personnel matters. In this period of turmoil, ESSG devoted much of its at-

tention to assimilating the experiences of the war and coping with the problems the conflict had generated.

* * *

Although studies relating to nuclear weapons and the war in Vietnam remained a substantial segment of the ESSG study repertory in the early 1970s, the largest single group of studies, accounting for almost one-fifth of ESSG's publications, was in the area of military engineering. As a study organization in the Corps of Engineers, work in military engineering and Engineer-related subjects had always been a major concern of the group but in the first half of the decade there was a noticeable peak in these studies. As the war in Southeast Asia wound down, the Army again focused its attention on Europe. Although many of the problems associated with a war in Europe were unchanged, new political and military considerations and new technology tested in Vietnam necessitated a thorough reevaluation and revamping of the Army's plans for a European conflict. Much of ESSG's work in military engineering was caught up in this reassessment of what now became the Army's greatest preoccupation—the European theater.

Two years prior to the end of American involvement in Southeast Asia, ESSG published its first major study of the responsibilities and resources that Engineers could expect to have in a NATO war. In *Engineer Estimate, Europe* (EEE 70), the group determined "how the USAREUR [U.S. Army, Europe] Engineer can accomplish his wartime mission."[89] The study identified the wartime tasks of the Engineers, estimated the troops and materiel required to accomplish the tasks, compared these requirements with the resources allocated to the Engineers in the existing war plans, and recommended measures to deal with the deficiencies. The first objective of the study, identifying the Engineer tasks, turned out to be the most difficult one and involved more than 60 percent of the study effort.[90] Because few of the tasks were quantified in the war plans, ESSG began by drawing up a series of scenarios covering various contingencies and then calculated the Engineer tasks in these scenarios. The war plans also did not include a base development plan, which the group had to develop in order to ascertain Engineer tasks in the communications zone. Although identifying and quantifying the Engineer responsibilities in a NATO war was a complex task, ESSG's experience in developing scenarios, such as SPECTRUM, and in base development planning equipped it to perform these operations.

The comparison of the requirements for troops and materiel that ESSG had generated with the resources allocated by the war plans at that time revealed serious deficiencies. It became apparent that the disparity was most severe in the combat zone during the first few days of a war. As a result, the USAREUR Engineer would have to "employ available resources only for the highest priority tasks, employ expedients for some of the re-

maining priority tasks, and disregard other tasks."[91] Of the Engineer combat zone responsibilities, the study concluded that the construction of barriers and field fortifications and the construction and repair of roads were the most important, with barriers requiring the highest priority. Even with drastic reductions in the performance of other Engineer missions, the group maintained that "more D-Day forces are required to provide combat support; there are no expedient means for accomplishing this."[92]

EEE 70 also revealed serious shortages in the materiel and troops available for the communications zone, where the most important Engineer responsibility was base development (see figure 32). In 1971 theater stocks were very low and "an improvement in the USAREUR base development materiel status is unlikely as long as supply priorities are directed toward support of SEA [Southeast Asia] operations."[93] While it was generally assumed that much of the materiel could be obtained locally in Europe, the situation would be critical if in fact these supplies and equipment were not available. More important than the assumptions about supplies were the assumptions about personnel. During the 1960s, American military plans had assumed that German troops and civilians would perform an ever-increasing number of engineer support missions, but according to the *Estimate*, the United States and West Germany had not drawn up firm plans for providing this host-nation support. The lack of clear agreements made planning the American Engineer workload difficult, especially for the first few days of a war when expediency and improvisation might not suffice.[94] In spite of the deficiencies in the communications zone, the study asserted that combat zone tasks were the most important, "because base development problems ultimately lose all meaning if combat power and the complementary engineer support are insufficient to withstand the enemy."[95]

Although the *Estimate* concluded with the recognition that "little can be done today in the way of increasing the number of in-country engineer combat battalions,"[96] it expressed a faint hope that the change in national strategy from a 2½ war conception to a 1½ conception might enable troops based in the United States to arrive in Europe more rapidly. While the *Estimate* could not hope to solve all the problems facing the USAREUR Engineer, ESSG felt that the study itself was an important beginning and needed to be updated regularly. At the very least, EEE 70 provided the Engineers in Europe with a better idea of the enormous wartime responsibilities that might ultimately confront them.

Two years later, in May 1972, ESSG published another assessment of Engineer responsibilities and resources, but this study was broader in scope and in its conclusions. *Providing Integrated Engineer Resources for the Seventies* (PIERS) sought to "analyze the needs of the engineer system in light of present and future worldwide mission requirements, to identify critical shortfalls in engineer capabilities, and to provide solutions which

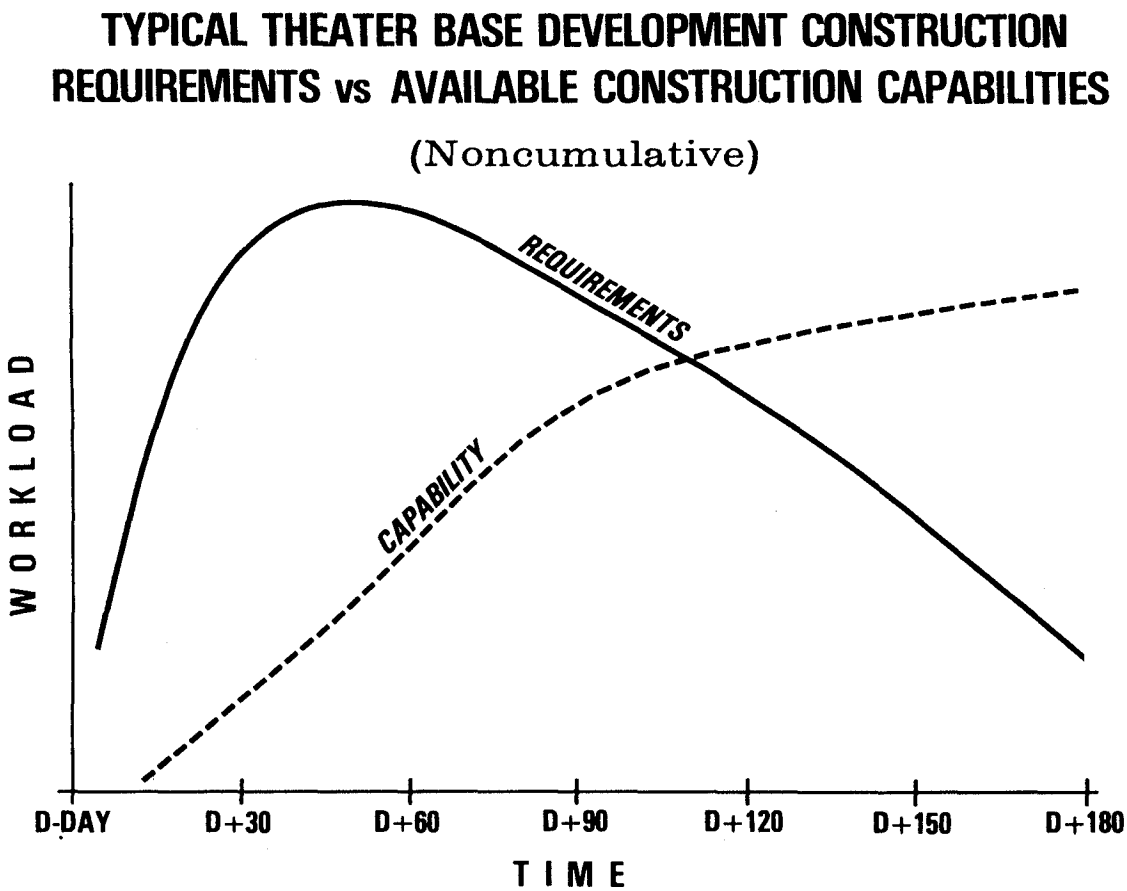


Figure 32

will most efficiently use the available engineer resources of the 1970s."[97] The study began with a thorough analysis of the past and future missions and resources of the Engineers, and then proposed organizational changes that would allow more efficient fulfillment of the projected Engineer roles. While many Engineer tasks would be the same, others would be altered as a result of the experiences in Vietnam and the changed situation in the European theater. PIERS predicted that after Vietnam, air mobility would play a larger part in a NATO war, and thus the Engineers would have increased responsibilities to support airmobile operations.[98] Because the Army anticipated even more difficulties in halting a Warsaw Pact invasion of West Germany, the study concluded that "an increased capability is required for hasty construction of barriers and rapid neutralization of enemy obstacles."[99] Confronted with improved Warsaw Pact capabilities, the Engineers would need an even greater ability to assist troops in crossing gaps, providing "bridging for withdrawal and extrication operations as well as for offensive thrusts."[100] These were only a few of the areas in which PIERS projected that the Engineer workload in Europe or elsewhere would be altered and intensified. The prospect of increased responsibilities without

increased personnel would force the Corps, according to the study, to improve its flexibility and efficiency.

ESSG felt that the key to increasing flexibility was a thorough reevaluation of the organization of Engineer units in light of the new Engineer responsibilities:

> The PIERS approach to achieving flexibility is based on the fact that most engineer tasks have some features in common (e.g., some of the same skills and equipment used to build a road are also used to build an expedient airfield). By examining the four major task groupings,[101] the habitually required skills and equipment have been identified. With these data, division, corps, and army engineer battalions have been organized to reflect these required capabilities.[102]

In place of the existing Engineer unit organization, PIERS proposed forming small, flexible units easily tailored to a specific mission or missions.[103] An examination of the specific combat and construction support missions that the Engineers would face in a wartime situation served as the basis for the organizational changes that PIERS proposed. With Engineer organization specifically drawn up to reflect Engineer responsibilities, the group felt that both flexibility and efficiency would be enhanced.

PIERS addressed materiel problems as well as organizational problems. The study identified the overriding engineer materiel trend as "the growing sophistication of engineer equipment. This is directly contrary to the engineer's need, especially in the combat zone. Engineer equipment introduced in the seventies must be simple to operate and maintain, as lightweight and compact as possible without degrading its capability to perform its primary function."[104] Because PIERS assumed that the all-volunteer Army would include soldiers with lower skill levels and more training problems, equipment would need to be simple to operate, efficient, and durable. Even with improvements in organization and equipment, PIERS agreed with EEE 70 that the Engineers faced a difficult situation in a NATO war: "It is apparent, however, that the sheer magnitude of the engineer mission in the combat zone will remain in excess of the engineer force capability presently envisioned."[105] Both EEE 70 and PIERS represented attempts to coax as much capability as possible from the constrained Engineer resources that were anticipated during the next decade.

The Engineer mission in a NATO war was particularly important because the Engineers were responsible for emplacing barriers intended to offset the numerical superiority of Warsaw Pact forces. Barriers had been an integral part of American military planning for a war in Europe since the early 1950s, when ESSG had drawn up its first comprehensive plan. With the renewed emphasis on the European theater, previously expressed doubts about the military effectiveness of barriers reappeared in the early 1970s. In the process of drawing up the *Engineer Estimate, Europe*, ESSG discovered

that creating barriers during certain periods would require a substantial commitment of the total available combat Engineer effort. In view of this requirement of resources, the group initiated a study "to evaluate the expected contribution of barriers to the defense."[106] Earlier ESSG studies had used the delay imposed on the enemy as the measure of barriers' effectiveness, but the group acknowledged that "differences of opinion arise between tacticians as to the worth of any obstacle placed in the path of the enemy. Some would even prefer to have obstacles omitted altogether in order to retain the maximum flexibility of movement."[107] After an analysis of barrier plans for Europe, the study concluded that "much uncertainty surrounds the measurement of the effectiveness of barriers."[108] If delay were the primary function of barriers, then the study results indicated that "lacking a quantum change in doctrine and (or) materiel, it also appears that increased delay is largely achieved by increased effort but at ever diminishing relative rates."[109] It was not clear from the study "that delay is the assured benefit of barrier operations,"[110] because an enemy might be able to circumvent the obstacles as had been the case with the Maginot Line. In addition, effort spent on barriers might actually be harmful if it detracted from the primary objective of destroying the enemy or if it diverted Engineer effort from other crucial missions, such as enhancing the mobility of friendly forces. As a result of the questions raised by the study, ESSG felt that "the effort expended on barriers by all combat zone forces must be weighed not merely in terms of an illusive measure such as delay, but rather in the larger context of what that effort contributes to enhance our combative (lethal) posture vis-à-vis the assailant."[111] The group recommended that the static analysis focusing on the concept of delay be replaced by a dynamic, war gaming analysis that might be better able to measure the effectiveness of barriers.

Almost two years later ESSG returned to the subject of barrier effectiveness. In December 1973, the Assistant Chief of Staff for Force Development indicated to the Chief of Engineers that current Army combat simulation models or war games did not credibly measure the effectiveness of barriers: "The primary effects of barriers obviously include imposition of losses of time, personnel, and equipment on the opposing force. Our inability to quantify these effects leads to uncertainty about the value of barriers and consequently impinges upon our confidence in allocating the necessary resources."[112] ESSG then undertook an effort "to develop measures of obstacle effectiveness based on their interaction with weapon firepower."[113] Because measures based on the concept of delay were inadequate, the group felt that a measure that isolated the role of barriers in enhancing the lethal or firepower effects of weapons would be both more productive and convincing.

In the study published in March 1975, ESSG developed a simple computer model that in a preliminary way "permitted the measurement of

the enhancement of direct fire weapon firepower as a result of the employment of obstacles."[114] Obstacles in this model enhanced firepower by allowing defenders to engage the enemy later and at a preferred range, thereby increasing the effectiveness of direct fire weapons. Although delay allowed firepower to be more effective, firepower rather than delay was the object to be measured. While the ESSG model began the search for new measures to evaluate barrier usefulness, the model only applied to small unit engagements and needed expansion to apply to larger units.[115] In the face of many assaults on traditional barrier doctrine, the ESSG study represented an effort on the part of the Corps of Engineers to clarify and quantify the rationale for barrier operations.

Although much of the group's effort in barrier planning during the early 1970s was devoted to broad, theoretical discussions, ESSG continued to provide the "nuts and bolts" support to theater barrier planning. As had been the case in the 1950s, preparing barrier plans was a large and difficult task, especially for the USAREUR Engineer:

> Selection of the hundreds of individual obstacle targets that comprise the barrier system requires extensive coordination and ground reconnaissance by engineer and tactical units. Once the targets are selected, materiel and transportation requirements and storage locations necessary to support the obstacle emplacement must be determined and incorporated in the barrier plan. Preparation of this plan and management of the associated administrative and logistical data are major tasks for USAREUR. Performing these tasks manually taxes the limited personnel available, lends itself to human error and lacks flexibility.[116]

In March 1973, the USAREUR Engineer requested assistance in establishing a computer program and data bank to aid in barrier planning, and in 1973 and 1974 ESSG devised the system and helped USAREUR implement it.[117] In the 1950s the group had helped launch the barrier planning concept; in the 1970s it helped bring the concept into the computer age.

While ESSG continued its work in areas of military engineering of longstanding interest, the group also expanded into new areas. Some Army aviators had recognized the military potential of the helicopter since the Korean War, but the Vietnam War had demonstrated the significant role that helicopters could play in military operations. When the war ended, the Army turned its attention toward the uses of the helicopter in a European war.[118] In early 1972, ESSG examined one of the first questions—how to deploy the aircraft from the United States to the theater of operations.[119] As in its earlier strategic mobility studies, ESSG investigated alternative deployment systems, including self-deployment (in which the helicopters refueled on stationary aircraft carriers as they flew to Europe), airlift on large cargo planes, sealift, and finally prepositioning in Europe. The study established and compared the technical feasibility, deployment

time, and cost of the various alternatives and recommended the ones that were most suitable given various other constraints.

A month later the group published the first of three studies that examined the influence of terrain characteristics on helicopter use in antitank warfare. The first study isolated the significant terrain features of two small model areas on the West German frontier and located areas with similar characteristics on Army bases in the United States. From these areas, the Army could choose a test site for antitank tactics.[120] In June 1972 and March 1973, two similar studies examined the terrain of the West German-Warsaw Pact frontier in order to determine how extensively helicopters could use "pop-up" tactics.[121] Pop-up tactics allowed the vulnerable helicopter to conceal itself behind terrain or other masking features until it could soar or "pop up" briefly in order to fire an antitank missile (see figure 33). The Advanced Helicopter Task Force of the Combat Developments Command and the Office of a Deputy Under Secretary of the Army sponsored the respective studies. While the second study considered a larger segment of the frontier, both calculated the proportion of the area under analysis that would be appropriate for the pop-up tactics. All three of these terrain masking studies were early efforts in determining how the experience obtained in Southeast Asia could be appropriately applied to the very different conditions in Europe.

In addition to work on barrier planning and helicopters, the group studied a variety of other topics in military engineering. In April 1972, ESSG published an evaluation of an Air Force proposal for a new short take-off and landing (STOL) transport plane.[122] After comparing the characteristics of the existing C-130 transport with the proposed aircraft, the group recommended that the Army oppose development of a new transport plane.[123] Earlier in 1970 the group had expanded its 1969 effort to develop a methodology for determining the best use of resources to improve the Corps' military engineering capabilities.[124] In two studies released in 1972, the group examined the Army's cover and deception techniques.[125] After an investigation of the Warsaw Pact threat and the Army's current doctrine, ESSG concluded that "a lack of emphasis on maintaining high level proficiency has allowed Army cover and deception capabilities to become less than acceptable."[126] The second study concluded with a list of recommendations for improving the capability.

Because the Corps of Engineers expected a large number of tasks in a European war, the ESSG studies in military engineering covered a broad range of topics. As the war in Southeast Asia wound down, the Corps and ESSG turned once again toward Europe in an attempt to reevaluate long-established techniques, such as barrier planning, and to adapt newer techniques, such as helicopter warfare. On an even broader scale, the Corps, like the Army, had to reassess its responsibilities and resources in the face of

HELICOPTER "POP-UP" BEHIND TOPOGRAPHIC MASK

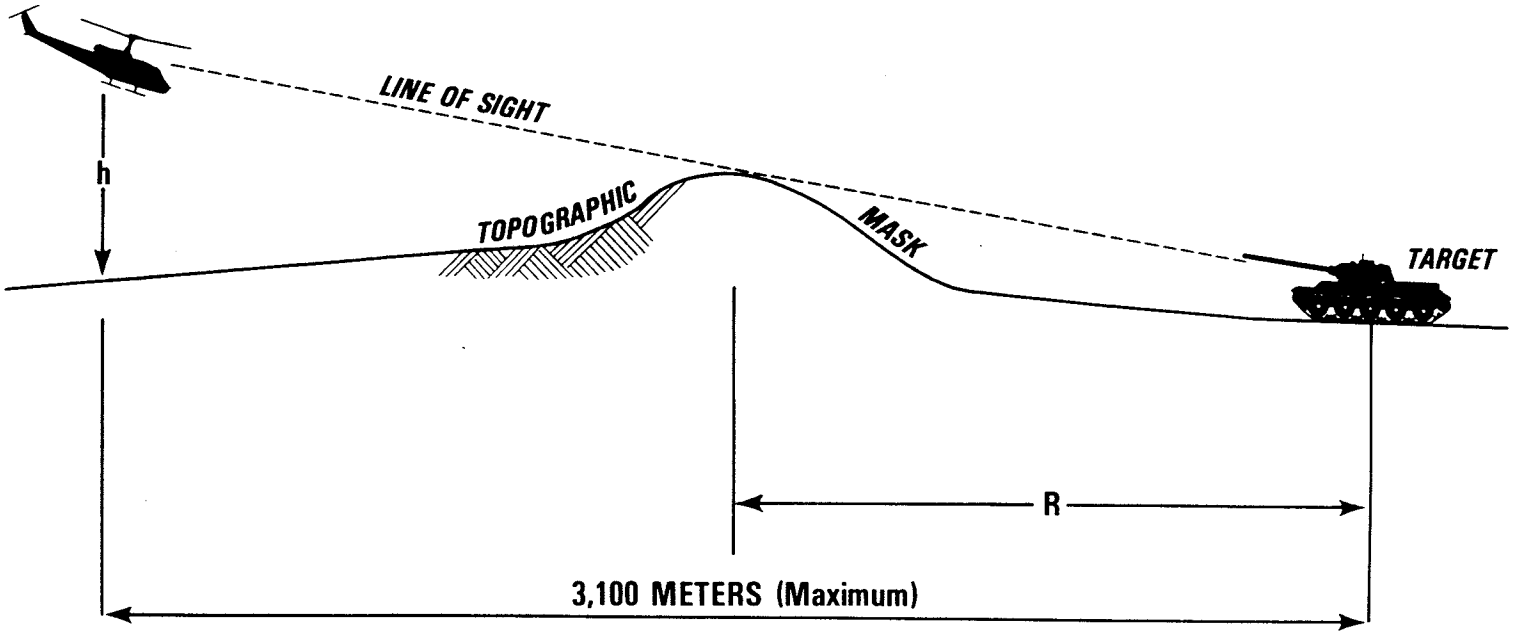


Figure 33

the changing circumstances of the early 1970s. In EEE 70 and PIERS, as well as in its other studies, ESSG participated in this reassessment.

* * *

Since the Kennedy administration's emphasis on general purpose forces, the Army had been concerned with the often difficult problem of determining the size and composition of forces needed to handle the variety of military contingencies that might confront the United States. ESSG had begun work on force requirements in 1962 with the *Conventional War Forces* study and had continued its involvement with the landmark SPECTRUM scenarios in 1968. In the early 1970s, ESSG returned to the topic with a variety of studies, less extensive than SPECTRUM, but devoted to a series of changing contingencies that confronted the Army in the transitional period ending with a renewed emphasis on Europe.

Although SPECTRUM had only been published in 1968, two years later DCSOPS asked ESSG to reevaluate its validity. The group decided that circumstances had changed enough to merit substantial modifications in the scenarios for the 1972–1979 period.[127] These circumstances included changes in national strategy and allied troop deployments and improvements in certain war gaming techniques. In July 1971 the group published a "limited update" of SPECTRUM including new manually computed force requirements for conventional wars in six of the original eight scenarios.[128] ESSG did not revise the other scenarios because the Army had not approved any model "as an accepted indicator of counter-insurgency force requirements."[129] With these adaptations, ESSG expanded the utility of SPECTRUM into the late 1970s.[130]

In the SPECTRUM scenarios, as well as in many other Army simulations, the measure used to determine the outcome of engagements between two opposing forces was the relative firepower potential (FPP) of all the weapons in the two forces. In 1971, DCSOPS asked ESSG to prepare two estimates of force requirements based on terrain and unit frontages and to compare the results with those based on FPP.[131] The studies examined the terrain of the NATO Central Region and the South Korean frontier to determine the size of the combat zone and any internal obstacles that might affect enemy deployment. Using these physical dimensions, terrain features, and enemy military doctrine, ESSG calculated the maximum number of enemy forces that could be reasonably expected to attack. The group then used the same procedures to determine the number of allied and American troops needed to halt the attack. In both cases, ESSG concluded that "force requirements derived on the basis of terrain and unit frontages exceed those computed by the use of firepower potential."[132] Conventional force requirements were difficult to determine because of the wide variety of possible military situations and the many simulation techniques that

could be used to generate plausible, yet sometimes conflicting, results.

In 1972 and 1973, ESSG did four studies of force requirements that reflected the continuing American military preoccupation with Asia, but all of these studies were devoted to projections for the mid-range period of the late 1970s. The study of Army requirements for prepositioned overseas materiel configured to unit sets (POMCUS) in the Pacific, which was similar to the strategic mobility studies, compared the cost and effectiveness of equipment prepositioned in land bases as opposed to that placed on forward floating depot (FFD) ships. The study concluded that POMCUS aboard FFDs allowed troops to deploy more quickly but that FFD POMCUS was substantially more expensive.[133] In a study that was soon outdated, the group determined the forces required to defend South Vietnam, Cambodia, and Thailand from attack by North Vietnam and China. Although the three-volume study carefully calculated the requirements, it noted that "the determination of land force requirements for Southeast Asia is a major problem for military planners. Available planning tools for analyzing theater-level land force requirements are designed to consider linear (or conventional) war situations, and cannot analyze nonlinear (or insurgent) war situations."[134]

In response to the Army's lack of an accepted nonlinear war model, ESSG began developing one for DCSOPS in late 1971 and published a "conceptual framework" for the model in April 1973.[135] The study postulated three primary missions in a guerrilla war: gaining control of specified geographic areas, maintaining control of these areas, and interdicting guerrilla base areas and logistical systems in enemy-controlled areas. In addition to an overall campaign plan, each mission required its own specific plan geared to its particular objectives. Each mission also involved certain functions defined as looking (finding the enemy), fighting, and defending critical installations. Although the study did not fully develop war game models for each function, it decided that the looking function was the most difficult and important and required a new, nonlinear model similar to the one used in SPECTRUM. Because they were more conventional functions, the fighting and defending functions could use linear war models. The force requirements for a counterinsurgency war would be the summation of the requirements for each function. ESSG warned that the overall model would only apply to military operations:

> It is designed to secure the governmental base areas and to disrupt armed opposition. This military action is required but will not lead to victory unless done in accordance with an overall plan that institutes the necessary reforms and political actions, lists the priority areas of the country, and is instituted by a viable government in accordance with the laws they have established.[136]

ESSG used the framework in a three-volume analysis of the forces required to defend Thailand from an attack by North Vietnam and China.[137] The study computed requirements for countering both a conventional attack by regular forces and a guerrilla war behind the front lines. Although the group devoted a substantial effort to developing the framework for a nonlinear war model, it acknowledged the need for a great deal more work to make it fully operational. Perhaps the timing of the publication helps to explain why DCSOPS never asked ESSG to complete the model.

When the Army turned its attention back to Europe, it had to assess the uses of forces developed during the 1960s in the type of warfare expected by NATO:

> Force planning and programming guidance require that top priority be given the defense of NATO Europe. Armored and mechanized divisions are generally accepted as best suited for most European operations. The Army must also be capable of deploying forces to meet other worldwide requirements and for that purpose needs airborne, airmobile, and the infantry divisions.[138]

DCSOPS asked ESSG to examine the possible roles for airborne, airmobile, and infantry divisions in Europe. After examining the characteristics of each type of division, the study concluded that each could perform certain carefully specified functions: "The airborne division is designed, organized, and equipped for rapid deployment by air. It is well suited as a strategic reserve maintained in a high state of readiness."[139] The airmobile division was also suited for a reserve role, because "its high tactical mobility enables it to block enemy penetrations, screen open flanks, and counter enemy airborne and airmobile operations in rear areas."[140] Both types were better suited to operations like those in Southeast Asia but could be useful for specialized tasks in Europe. It was perhaps ironic that the infantry division, once the staple of every army, was the least adapted to the warfare envisioned in Europe. The American infantry division, lacking mobility and armor protection, was vulnerable to the blitzkrieg tactics expected of the highly mobile and heavily armored Soviet forces. The infantry division vulnerability was particularly acute in "retrograde operations."[141] After an examination of the terrain along the West German frontier, the study concluded that the "risk can be reduced by deploying infantry divisions in terrain where suitable alternative or successive positions are available in depth."[142] The infantry could then withdraw to prepared positions in the rear covered by terrain that "restricts enemy armored vehicle movement and provides concealment and good fields of fire for infantry troops and weapons."[143] According to ESSG, the Army could find appropriate roles for all its divisions if they were used in terrain and under conditions that exploited their strengths and minimized their weaknesses.

ESSG's force requirements studies were not confined to eastern

Asia and Europe. In 1971 the group developed a scenario for deploying an American force to the Middle East,[144] and then in 1975, at the direction of the JCS, it participated in a similar joint study with the Marine Corps.[145] Although the two organizations estimated requirements for different contingencies, they worked together on a common framework for the studies. This effort was unique because it was "the first time the Army and the USMC have collaborated in a joint study approach to develop force estimates for the JSOP" [Joint Strategic Objectives Plan].[146]

Although ESSG updated the SPECTRUM scenarios in 1971, most of its work in force requirements during the early 1970s concentrated more on specific geographic cases and less on the comprehensive, worldwide studies, like SPECTRUM and *Conventional War Forces*. Although most of the studies prior to 1973 reflected a continuing concern with eastern Asia, after 1973 the emphasis was on Europe and the Middle East. After establishing the groundwork for Army force requirements studies in SPECTRUM, ESSG studied more specific issues in the early 1970s. Then, by the late 1970s, most of the analysis of requirements passed to other Army agencies.

* * *

While force requirements studies occupied much of ESSG's effort in the field of general purpose forces, the group still worked on problems in force structuring and Army organization. During the early part of the decade, the Army budget was cut and its operations and organization in Southeast Asia and Europe came under attack. In the face of fiscal restraints and criticism, the Army looked more closely at its utilization of manpower and other resources at home and abroad. Critics charged that too few troops were destined to engage in combat with the enemy and too many provided support for this small combat force. Most of the ESSG studies in force structuring and Army organization assessed the Army's structure and functioning in order to determine if problems existed and how the Army could operate more efficiently with its scarce resources.

In the late 1960s the Army had developed a Resource Capability (RECAP) computer model that provided a profile of the costs and performance characteristics of each combat module. Combat modules were "battalion or company sized units which interact with the enemy."[147] RECAP allowed planners to aggregate the various modules in a force and quickly determine its costs and capabilities. Since firepower potential was the only combat capability measured by RECAP, the Assistant Vice Chief of Staff asked ESSG to devise additional measures of combat strength. The group examined 45 modules and proposed measures for short-term and sustained mobility, intelligence gathering, and command and control capabilities.[148] These measures along with FPP would allow planners to arrive at better estimates of the combat strength of a unit or group of units.

The Army was also concerned about the contributions support units

made to combat effectiveness. In a study published in 1972, ESSG examined available Army war games for an appropriate measure of the contribution that the Engineer effort made to the combat effectiveness of the total force. The group concluded that none of the models provided an adequate measure and devising a new model was not immediately practical because the task was so great.[149] However, the questions about the role of support troops, like that of the Engineers, persisted and became the subject of several ESSG studies later in the decade.

One of the most controversial areas involving support troops was the old "tooth-to-tail" debate:

> A great deal of Congressional, National Security Council staff, and Office, Secretary of Defense criticism has been leveled against the Army over the contention that its forces have a low combat-to-support manpower ratio. Nongovernment sources, such as private contractors, also have made such criticisms. At the same time, it is often held that foreign military forces (particularly Soviet) have just the opposite structure, with the bulk of their forces in combat elements. As a result of such contentions, there are frequent assertions that the Army's support elements can be cut significantly without degrading combat effectiveness.[150]

In 1973, ESSG contributed extensively to a Corps of Engineers' review of a Rand Corporation study criticizing the Army's support structure, and early in 1974 DCSOPS asked the group to publish its results in a study entitled *Combat-to-Support Ratios*.[151]

Although ESSG could not have been labeled an objective observer of the debate, it did provide some warnings about superficial discussions of the ratios:

> Unfortunately, the terms "combat" and "support" are used so loosely by various sources that it is difficult to derive meaningful figures without first defining the terms. Precise ratios of U.S. combat-to-support forces can be developed using established guidelines, but determining foreign combat-to-support ratios becomes more difficult because of such things as structural differences, geography, troop support, and the lack of definitive information. Critics of the U.S. Army's support structure, however, are inclined to use one method in developing combat-to-support ratios for the U.S. Army and another (largely due to the lack of data) for foreign forces. Comparing foreign forces using different computational methods leads to erroneous conclusions.[152]

Because the Soviet Union did not disseminate precise information on its force composition, the Army and its critics had to devise measures based on the scanty data available. Even within the Defense Department, there was a variety of methods for computing the Army's combat-to-support ratio. ESSG used several of these methods to compute ratios for the FY 74 projected forces and discovered that "the 'combat' personnel percentage

ranges from 24 to 74 percent."[153] With the paucity of Soviet data and wide discrepancies in Defense Department figures, the group formulated its own "highly aggregated, straightforward" methods for computing ratios that could be compared.[154] The methods considered either a fraction or all of a division's personnel as combat and the rest of the Soviet and American armies' military personnel as support. Computations by the ESSG methods revealed "only a modest imbalance between the force structures of the U.S. and the Soviet Union."[155]

Whatever the method used to compute the ratios, the group also contended that ratios were not reliable indicators of the combat capability or effectiveness of the two armies. Other factors made the force composition of the two armies different. Soviet forces were supported by overland lines of communication relatively close to the homeland, while American lines of communication stretched a considerable distance over more vulnerable sea and air lanes.[156] The Soviet army was designed for rapid blitzkrieg tactics while the American Army was structured to resist and outlast this intense offensive thrust. As a part of its strategy to block the Soviet attack, the United States had provided its Army with highly complex and technical weapons and equipment. As a result, this force "required a larger support force (particularly for maintenance in the forward areas) than one equipped with less sophisticated systems."[157] In addition, the United States had to be prepared to deploy troops in a variety of geographic areas and needed a support structure adequate for all these contingencies. The study then reasserted the often-mentioned contrast between American and Soviet soldiers: "A force conscripted largely from a peasant-type economy can dispense with many amenities (and their resultant support requirements) that are provided a volunteer force accustomed to a higher living standard in a democratic society."[158] All of these factors led ESSG to conclude that "it should be apparent that the combat-to-support ratio of one force cannot be used as a design criterion for structuring another force existing within different constraints and considerations. There is no optimum fixed ratio that meets the requirements of diverse contingencies. Ratios shift within forces as conditions change or as the forces themselves increase or decrease in size."[159] ESSG's experience in force structuring, which went back to the Force Planning Guides of the 1960s, convinced it that combat-to-support ratios should be flexible factors dependent on the purposes and the environment of the force under consideration.

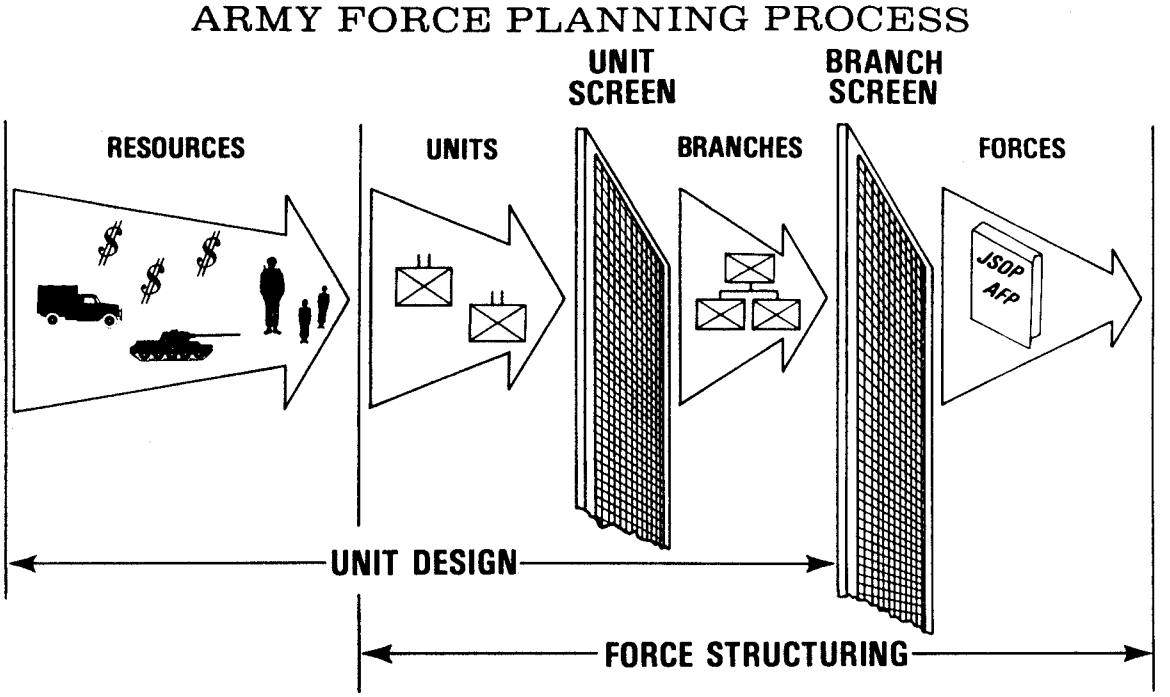
During the same month, May 1974, in which ESSG published the *Combat-to-Support Ratios* study, the group also published the first volumes of a major study that also grew out of the debate over support troops.[160] Force stratification analysis had originated in mid-1970 as an in-house effort to determine which portion of an Army force was engaged directly in the destruction of the enemy, which portion supported these combat forces, and which portion engaged in more remote support.[161]

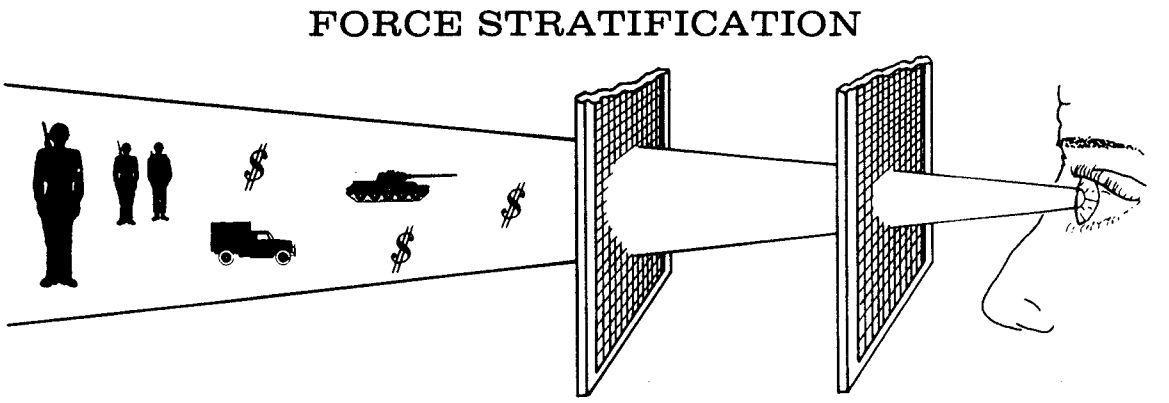
Over the course of the next four years, the project grew in scope and complexity until it resulted in "an automated stratification procedure to determine what percentage of the Army's total manpower and equipment is devoted to specific functional areas."[162]

ESSG asserted that force stratification analysis was needed because the Army's force planning process operated on two levels: the micro or unit design level and the macro or force structuring level (see figure 34). At the micro level, the Army combined resources (personnel and equipment) to form units and then combined units to form branches. At the macro level, it combined branches to form an Army force. At the micro level, units were designed to make the most efficient use of resources with each having its own internal support system for functions like maintenance, food service, supply, and administration. As the individual, highly self-sufficient units were combined into branches and Army forces, there would be an unnecessary duplication of support functions.[163] "The total Army may indeed have an excess of self-sufficiency."[164] The usual force structuring procedure at the macro level, however, disregarded "the fact that all personnel assigned to Army units are not engaged in the primary mission of the unit."[165] For example, in medical units many administrative, maintenance, food service, and supply people did not perform medical functions. On the other hand, medical personnel served in units that did not perform medical services as their primary function. In establishing the force stratification procedures, ESSG assigned all military personnel in Army units to 1 of 64 functional categories that best characterized their function, and calculated the recurring and nonrecurring costs for each individual and piece of equipment.[166]

Force stratification allowed military planners to analyze any Army aggregate at the level of the individual soldier and piece of equipment and provided a data base and a tool for Army planners who were examining the composition, expense, and functioning of Army aggregates at all levels. ESSG hoped "that output from this analytic tool would give the macro force planner new insights into the true allocation of resources within a structured force and give the micro force planner a basis for new notions on the design of units within the context of a total force."[167] Lieutenant General William E. DePuy, Assistant Vice Chief of Staff and later Commander, Training and Doctrine Command (TRADOC), sponsored ESSG's work and became an enthusiastic supporter of force stratification.[168] ESSG gave briefings on the study to a large number of general officers and to the Assistant Secretary of the Army for Research and Development. In 1974 and 1975, the group published four volumes on the procedure and the computer programs associated with it.[169] Although ESSG had designed the system, the group wanted another agency to assume responsibility for its routine operation, and in the spring of 1975 the Army staff transferred the system to the TRADOC Systems Analysis Agency.[170] From its inception,

A NEW VIEW OF ARMY FORCES





ASSIGNS RESOURCES TO PROPER FUNCTIONAL AREA

EXAMINES ARMY ORGANIZATIONS (By Branch and Zone) FOR INFORMATION ON:

- ***SPAN OF CONTROL***
- ***GRADE DISTRIBUTION***
- ***BENEFICIARIES***
- ***COMMAND AND CONTROL***
- ***STAFF SUPPORT***
- ***CENTRALIZATION/DECENTRALIZATION***

Figure 34

force stratification was a controversial subject within the Army. Some felt it exaggerated the ratio of "teeth-to-tail" and encouraged the conception that the Army fought as a collection of individuals instead of as a collection of units in which individuals performed a multiplicity of tasks. ESSG maintained, however, that force stratification analysis was a tool that provided insights into the workings of the Army that other analytic tools neglected.[171]

In 1973 and 1974 ESSG also produced two other studies of Army organization. By 1973 the current Army Transportation Plan (ATP) was almost eight years old, and there was a new interest in better transportation planning in support of the Army's contingency war plans. The group examined the transportation planning process and made a series of recommendations to make it more efficient and useful.[172] By 1974 the Army also decided that its fleet of watercraft was becoming obsolete and asked ESSG to assess "the advantages and disadvantages of having the Navy fulfill current Army watercraft responsibilities."[173] The study concluded that "the Army is most concerned with buildup and sustaining land combat forces. The Navy/USMC is concerned with safely projecting a combat force ashore against a hostile force."[174] Thus the Army should continue to operate watercraft for logistical purposes, leaving amphibious assault craft under the control of the Navy. Both of these studies reflected a renewed Army interest in subjects that had lain dormant during the war in Vietnam.

The ESSG studies of force structuring and Army organization in the early 1970s focused on providing the Army with a better understanding of the capabilities and functioning of the resources it had at its disposal. In a period of declining budgets and increasing criticism, the Army needed to determine the most efficient and effective use of its manpower and equipment. Although some of the group's work was controversial, ESSG attempted to provide tools and analyses that would help the Army to adapt to its new circumstances.

* * *

Effective use of manpower and materiel was also a theme in ESSG's work in base development planning (BDP). One of the earliest lessons of the war in Southeast Asia was that the Army was inadequately prepared to provide the base facilities required by a large American force. ESSG was among the first group of Army agencies that began working to remedy this deficiency. In the late 1960s much of this effort went to defining the tasks and requirements involved in base development planning. By the early 1970s, BDP became standardized and automated as the lines of responsibility for the planning became clearer and the assistance provided to base development planners in the theater became more extensive.

Although the JCS established the format for BDP, the theater com-

manders were responsible for drawing up base development plans to accompany their operations plans. Base development planning was a complicated and time-consuming process, and because the theater staffs had neither the manpower nor the computer facilities to complete their plans within the time of the normal JCS planning cycle, most BDPs were years out of date. Yet, while the theater staffs needed assistance, they hesitated to have theater planning done by the staff in the Pentagon. To solve this problem, ESSG in 1971 established the Base Development Planning Assistance Office (BDPAO) as a subdivision of the group. The BDPAO provided the necessary assistance, working directly with and for the theater commander, who retained final responsibility for the plans. Throughout the 1970s the BDPAO of ESSG was one of the focal points for Army base development planning.[175]

By 1970 the JCS had provided detailed specifications for BDPs, which were required to include "an engineering intelligence annex, listings of facility and installation requirements and assets, time-phased construction project lists and bills of materiel, and any pre-D-Day construction program that is appropriate."[176] ESSG prepared three of these plans in 1970 and discovered that "each required an average of 23 man-months of effort. It became apparent that computer support would be necessary to reduce this effort and meet the schedules required of the unified commanders."[177] ESSG's base development planners and computer programming specialists worked together to develop the Computer Assisted System for Theater Level Engineering (CASTLE). The CASTLE program took as input a list of troops to be supported in an operations plan, a master file describing the types of units in this troop list, and a time-phased force deployment list specifying when the troops would arrive in the theater. Using these data, CASTLE generated a list of all facilities required to support the troops in the planned operation, the times when the facilities could be completed consistent with the availability of resources and the facilities' importance, and tabulations of construction projects in the required JCS format.[178] In the early 1970s ESSG produced more than 20 new and revised BDPs—a feat that would have been impossible without CASTLE.[179] Eventually CASTLE was linked with other Army simulation models to improve and expedite logistical planning.

In addition to the large number of BDPs, ESSG published a number of supporting documents that explained and amplified the CASTLE system and BDP in general.[180] Analysts from the group gave briefings on BDP to a number of Army agencies and schools and established contacts with base development planners in the other services. ESSG's special study of base development in Europe, published in 1973, coincided with the Army's reorientation toward the European theater.[181] Using CASTLE, ESSG generated an extensive data base for BDPs along two alternative lines of communication in Europe. Since American lines of communication in

Europe were vulnerable to attack, the Army felt it needed a number of options in planning for a NATO conflict. By the mid-1970s ESSG had the ability to produce both standard and special BDPs that were comprehensive and readily available.

Although base development planning was becoming a standard part of the Army planning process, ESSG felt BDP needed careful management. In 1971 and 1972 the group examined Army staff policies and procedures in order to ensure that BDP fit into the Army planning, programming, and budgeting system.[182] The study concluded that responsibility for base development was properly lodged with the Deputy Chief of Staff for Logistics (DCSLOG) and the Chief of Engineers and recommended several changes that defined the responsibilities of the two agencies more clearly. Most of these recommendations were later embodied in a Chief of Staff regulation. In ESSG's opinion, base development was an often neglected but highly important part of military planning. The logistical confusion associated with the initial deployment of American troops in South Vietnam had demonstrated the importance of careful planning—planning that might be even more critical in a situation in which the United States did not have the option of muddling through. In addition, base development planning was not expensive, an important factor to a peacetime Army faced with declining budgets. Even though BDP was relatively inexpensive, the group felt it was "vital to successful contingency plans."[183] According to ESSG, the United States need not be caught without careful and comprehensive plans for base development.

* * *

Because ESSG had broad experience in Army planning activities, the field of management analysis evolved naturally from its earlier work. The first of these management studies appeared in the early 1960s, but the number increased substantially during the next decade. Prior to 1970 the Corps of Engineers had sponsored most of the management analyses, and this trend continued. As the field expanded, ESSG did management studies for other government agencies as well, including the drug abuse studies discussed earlier. Other topics ranged from techniques for Corps emergency planning to land clearance strategies. With the Corps remaining the primary sponsor, the field became an important area of concern for ESSG throughout the 1970s.

In late 1973 ESSG developed a set of objectives for the Corps' research and development program.[184] The combination of military and civil functions complicated formulation of reasonable objectives. ESSG reviewed the Corps' missions and established a set of desirable general characteristics for research and development, including user satisfaction and environmental awareness. From this foundation, the group defined a

set of goals that considered the limitations of budget and the need to capitalize on developments in the civilian sector.

In 1974 the group assessed the Corps' computer use and emergency planning activities. In 1973 the Deputy Chief of Engineers, Major General Daniel A. Raymond, had indicated that he felt that the Corps was experiencing "significant difficulties in the ADP field."[185] The ESSG review of the problem showed an increasing conflict between computer use for engineering and scientific analysis and the Corps' business operations. The study proposed changes in hardware and software, including delays in implementing certain new business programs and a reduction in automated reports, especially the "unnecessary and redundant" ones.[186] Effective implementation of these changes, according to the study, depended on the concentration of coordination and long-range planning in one Corps agency.

A similar recommendation accompanied the group's study of Corps emergency planning.[187] The Engineers had broad responsibilities in planning for civil and military emergencies, but ESSG felt that "the overall emergency planning system in use throughout the Corps is so complex and unwieldy that it is counterproductive, and at some headquarters, has resulted in planning that is inadequate to permit mission accomplishment."[188] To correct these deficiencies, the Corps should stress "simplification and consistency"[189] with an Emergency Operations Planner at each headquarters assigned clear responsibilities and given sufficient personnel and time for the job. As ESSG recommended, the Chief of Engineers transferred responsibility for emergency planning to the Director of Civil Works in May 1974.[190] In both studies, ESSG stressed the delineation of responsibilities and the allocation of necessary resources.

The group continued its management studies during 1975 with studies on land use alternatives, Army energy requirements, and performance assessment. In 1973 an Executive Order required federal agencies to determine which of their real property holdings were not being used. The Army had identified its excess property but some of it was contaminated by unexploded ordnance and chemical and biological materials. ESSG recommended further study of the chemical and biological problem and suggested clearing away the ordnance or using the land in other ways.[191] In two studies sponsored by the Facilities Engineering Support Agency of OCE, ESSG projected the energy requirements of Army installations during the period 1990 to 2000 and compared these requirements with Army energy consumption in FY 73.[192] In its Performance Measurement study, ESSG surveyed the management practices of a group of governmental and private organizations to identify those that might benefit the Corps.[193] The group set out to discover new performance measures but found that the overall management approach used by the organizations had greater applicability in the Corps. Relying on standard computer programs, the organizations

that ESSG studied used the computer systems "to forecast problems, to evaluate alternatives, and to foster open, direct communication. The goal is to manage in a predictive rather than reactive manner. In short, the idea is to improve efficiency and effectiveness by operating in a 'no surprises' atmosphere."[194] The study analyzed the elements of this approach and outlined "a broad scenario for improving Corps management."[195] After explaining the study to the Chief of Engineers, Lieutenant General William Gribble, ESSG found that he agreed that Corps management practices needed improvement.[196]

In the period of declining budgets, the Corps, like the Army, emphasized the efficient use and management of its resources. Clearer goals and objectives, more efficient use of resources like computers, better planning, and a more coherent management philosophy were all themes of ESSG studies. This emphasis on the improvement of Corps management persisted during the late 1970s.

* * *

During the early 1960s ESSG had pioneered strategic mobility studies, and in the early 1970s, the group continued this work, especially in the area of prepositioning war reserve stocks. During the period, ESSG also worked in mobilization planning. Both fields were concerned with the ability of the Army to shift from peace to war and to deploy troops to a threatened area or areas.

In 1971, DCSOPS for the first time asked ESSG to examine the Army mobilization process in order "to determine the capabilities of the approved active and reserve troop basis for FY 74–81 to meet specified deployment schedules"[197] under varying conditions of mobilization. The next year DCSOPS asked for a study of the FY 75–82 force, but one using a different procedure.[198] Both became part of the Army Strategic Objectives Plans (ASOPs). In addition, in 1973 the group published a study explaining the new approach it had used in the 1972 study.[199] Prior to 1973 "the general objective of ASOP/JSOP mobilization planning has been to isolate resource constraints (limitations) which prevent the mobilization of a projected force to meet projected contingencies. The results have been presented in terms of shortfalls in a given resource."[200] As a result, mobilization planning calculated separate resource requirements without exploring the influence of one resource requirement on others.[201] Moreover, the process did not include priorities for meeting the requirements.[202] With the Army shifting from conscription to volunteers, ESSG felt more integrated mobilization planning was imperative: "In a force structure which increasingly depends on Reserve components, the capability to mobilize becomes a critical element of the total force capability."[203]

Using its own computer simulation, ESSG analyzed the six activities that were critical parts of mobilization: organizing personnel, providing equipment, providing individual and unit training, stationing, deploying forces, and sustaining them in combat. The ESSG method considered the requirements and shortfalls of a given mobilization plan, identified the most troublesome deficiencies, and established a list of priorities for remedying these problems. Based on the resource levels projected in the plans, ESSG's procedures calculated how fast the force could be mobilized and predicted what kind of force could be mobilized within the limitations on resources.

The Army's plans for mobilizing and deploying forces overseas included prepositioned overseas materiel configured to unit sets (POMCUS). Depots in important areas contained equipment for particular units that could move quickly to the theater and there obtain their equipment. Initially, the Army had usually prepositioned complete unit sets of equipment, but in 1967 the Chief of Staff ordered studies of prepositioning selected unit equipment.[204] The study sought to determine if selective prepositioning could reduce storage and maintenance costs in the theater while improving the process of mating personnel with their prepositioned equipment. With the help of a special Army committee, ESSG developed a computer program to select equipment for prepositioning and equipment for transportation with the troops from the United States. This study of selective prepositioning and two others on POMCUS operations plans and the vulnerability of POMCUS and war reserve stocks provided critical analyses of the system and made recommendations for improvement.[205]

Both mobilization planning and strategic mobility were important factors for a small, all-volunteer Army that had to mobilize reserves in order to reach full strength and had to transport units quickly from the United States to theaters overseas. Without these capabilities the nation would be unable to project its forces effectively in emergency situations.

* * *

In the early 1970s, ESSG's wide variety of topics reflected the diverse interests of the Army staff. Some issues, such as Army stationing or the operational feasibility of military systems, had long been ESSG concerns. Others, such as special engineering, were more recent interests. Still others relating to the Middle East grew out of the changing strategic and geopolitical environment.

The problems of stationing units in the United States was a continuing concern of the Army. In 1970, ESSG published a classified study analyzing "conditions that could affect the activities and stationing of CONUS army forces in the long-range time frame." Later two unclassified versions were released.[206] Many of the conclusions of these studies echoed predic-

tions made in earlier studies like PAVUS-75. Although ESSG felt that the basic economic and political structure of the world in the year 2000 would be similar to the current one, some of the disparities would be intensified. Because population growth in the Third World would probably exceed increases in food production, the gap between the rich nations and the poor nations would widen, leading "to increasing social dissatisfaction, envy, and political hostility."[207] This dissatisfaction could produce more worldwide tension, but since the United States and the Soviet Union would remain the world's greatest powers, their relationship would be the key to world peace. The strategic importance of Europe and increasing American dependence on oil from the Middle East meant that these two regions would be vitally important.[208]

ESSG predicted that the gap between rich and poor would also increase within America, leaving poor blacks concentrated largely in urban ghettos. Blacks and university students would continue to be prone toward civil disorders, but stationing Army units near predicted centers of disorder would not be feasible or helpful. Because Army bases had little economic impact except in some rural areas, stationing could not greatly affect the economic conditions in cities, and the high price of urban real estate precluded establishing new metropolitan bases. Morever, "it is difficult to predetermine the location of civil insurgencies; there are Negro ghettos and universities in all large cities in the U.S.; therefore, stationing of the Army in CONUS near certain metropolitan areas in anticipation of disorders is impractical."[209] With the development of jumbo aircraft and fast ships, the studies predicted that the Army could deploy rapidly, so proximity would not be such an important factor. According to ESSG, the Army should not adopt any major new approaches to stationing.[210]

Like Army stationing, studies of weapons systems had appeared periodically in ESSG's history. In addition to the studies of infiltration monitoring devices and the effectiveness of obstacles in barrier planning, the group did a study for Wilbur B. Payne, Deputy Under Secretary of the Army for Operations Research, on the new wire-guided antiarmor weapons.[211] Because use of these weapons required an unimpeded line of sight from the gunner to the target throughout the flight, the Army needed to know how widely these weapons could be used on potential battlefields. Drawing on its extensive experience in terrain analysis, ESSG examined the traditional invasion routes into West Germany and classified the terrain that was suitable for use of the wire-guided weapons. The method was meant to serve as a fairly simple technique for evaluating the terrain in other areas as well.

In the early 1970s, ESSG also continued the special engineering project. Using all-source intelligence, ESSG completed the series of 11 studies begun in 1969 on the environmental effects of underground nuclear testing. Sponsored by the Advanced Research Projects Agency (ARPA), these

studies identified sites in specified areas that might be suitable for underground testing.[212] In another study published in January 1972, ESSG developed a scenario for a foreign clandestine nuclear test in a secret decoupling chamber.[213] A decoupling chamber was a large underground vault that would muffle the seismic waves produced by a nuclear explosion and thus make its detection difficult. While construction of such a chamber was possible, ESSG concluded that the task was so huge that the project would be difficult to conceal. Furthermore, the areas where it could be built were so limited that they could be monitored effectively.[214] In 1973 and 1974 the group produced three more studies of covert underground testing.[215] The satellite techniques and the results of the studies remained highly classified.

The diverse collection of ESSG studies in the early 1970s was completed with three studies relating to the Middle East. In May 1971, ESSG prepared a terrain analysis for the Joint Chiefs of Staff.[216] The Joint Staff had prepared a plan for the phased withdrawal of Israeli forces from the Sinai peninsula and asked ESSG to propose four withdrawal lines based on a terrain analysis of the Sinai. When the JCS released the plan, the proposed lines were similar to the ones ESSG had recommended.[217] Later in the period, the group prepared and then updated "an overview of U.S. relationships with countries of the Middle East"[218] for the Office of the Secretary of Defense. These surveys covered all aspects of American policy and interests in the area and provided a data base for Defense Department planning.

Although subjects as diverse as Army stationing, satellite photography, and Sinai terrain analysis seemed to have little in common, they were all within ESSG's study repertory. Their diversity indicated ESSG's willingness not only to continue studies in its traditional fields but also to take on new projects that might require new skills or involve research on new subjects.

* * *

The transitional period of the early 1970s brought ESSG a wide variety of study subjects. As current military operations in Vietnam had declined as an area of study, the group focused more on the lessons that could be learned from the war. With the change in the Army's orientation from Southeast Asia to Europe, more of these lessons were applied to the European theater and the different circumstances that existed there. As part of an Army-wide effort, ESSG reexamined the old structure and functioning of the Army in order to find its weaknesses and adapt it to new budgetary constraints and new recruitment policies. Many of the older study areas, such as force requirements, force structuring, and barrier planning, continued to be important. But the group used new techniques, often

computer-related, and new approaches to reach its conclusions. The variety of ESSG studies increased as the Army and the Corps turned to the group for investigations into topics ranging from satellite photography to drug abuse, from base development planning to emergency planning, and from Sinai terrain analysis to Army energy requirements. The transition from war to peace had not simplified life for the Army or for ESSG. The new orientation toward Europe meant that older, neglected topics had to be reevaluated and new, unanticipated topics had to be mastered. The new decade brought with it a host of problems that required thought, study, and action.

Notes for Chapter VI

1. Lawrence J. Korb, *The Fall and Rise of the Pentagon: American Defense Policies in the 1970s* (Westport, CT: Greenwood Press, 1979), pp. 7–22.

2. John P. Rose, *The Evolution of the U.S. Army Nuclear Doctrine, 1945–1980* (Boulder, CO: Westview Press, 1980), p. 115. For a fuller discussion of the impact of the Yom Kippur War, see Rose, pp. 115–125; Robert A. Doughty, *The Evolution of U.S. Army Tactical Doctrine, 1946–1976*, Leavenworth Papers, no. 1 (Fort Leavenworth, KS: Combat Studies Institute, 1979), pp. 40–41; and Kenneth S. Brower, "The Yom Kippur War," *Military Review* 54 (Mar. 1977): 25–33.

3. Korb, *The Fall and Rise of the Pentagon*, pp. 26–28; and Doughty, *U.S. Army Tactical Doctrine*, pp. 40–46.

4. Jerome H. Kahan, *Security in the Nuclear Age: Developing U.S. Strategic Arms Policy* (Washington, DC: Brookings Institution, 1975), pp. 142–196; and Warner R. Schilling, "U.S. Strategic Nuclear Concepts in the 1970s: The Search for Sufficiently Equivalent Countervailing Parity," *International Security* 6 (Fall 1981): 48–79.

5. ESC, *Nuclear Weapon (ADM) Requirements, A Procedure for Analyzing Fixed Targets*, no. 190 (June 1970); and interview with Gerard F. Greco, Washington, DC, 10 Mar. 1982.

6. ESC, *Targeting Roles for Theater Nuclear Forces*, no. 240 (Jan. 1973).

7. ESC, *Theater Strike Plan Analysis*, no. 239 (Nov. 1973). See also the interview with John J. Taylor, Washington, DC, 18 July 1980.

8. ESC, *Weapon Requirements to Support Theater Nuclear Targeting Options*, no. 264 (June 1975). See also the interviews with Mr. Taylor and John U. Physioc, Washington, DC, 10 Oct. 1981.

9. ESC, *The United States in 1982: A Projection of Growth and Its Strategic Implications*, no. 188 (July 1970).

10. Ibid., p. x.

11. ESC, *Long Range Army Stationing—World and United States Environmental Considerations—2000*, no. 192 (May 1970).

12. ESC, *The United States in 1982*, p. x.

13. Ibid., p. xi.

14. Ibid., p. 15.

15. Ibid., p. xi.

16. Ibid., pp. xi–xii.

17. ESC, *Improvement of the Military Damage Assessment System*, no. 180 (Aug. 1969).

18. ESC, *Army Damage Assessment Handbook*, no. 199 (Nov. 1970), p. 2.

19. Ibid., p. vii.

20. Ibid., p. A–1.

21. Ibid., pp. 2–8.

22. ESC, *Army Damage Assessment Handbook;* ESC, *Army Damage Assessment System (ARMDAS) Handbook of Interim Operational Procedures*, no. 250 (Feb. 1973); and ESC, *Army Damage Assessment System Handbook of Interim Operational Procedures*, no. 262 (July 1974).

23. ESC, *Determining Army Personnel Residuals (PONAST II)*, no. 211 (Oct. 1971).

24. Annual Historical Summary, FY 72, ESC Historical Files.

25. ESC, *Reserve Components Survival Analysis—Preliminary Report*, no. 189 (Nov. 1970).

26. ESC, *Herbicides and Military Operations*, no. 219 (Feb. 1972), I: 5; and Guenter Lewy, *America in Vietnam* (New York: Oxford Univ. Press, 1978), p. 263. For a general discussion of herbicide operations, see Lt. Gen. John J. Hay, Jr., *Tactical and Materiel Innovations*, Vietnam Studies (Washington, DC: Government Printing Office, 1974), pp. 89–95.

27. Deborah Shapley, "Herbicides: DOD Study of Viet Use Damns with Faint Praise," *Science* 177 (Sept. 1972): 776; Lewy, *America in Vietnam*, p. 264; and interviews with Dean E. Considine, Washington, DC, 2 Oct. 1981; and Col. William G. Stewart, USA (Ret.), Washington, DC, 1 Oct. 1981.

28. ESC, *Herbicides and Military Operations*, I: 1.

29. Ibid., pp. 6–7.

30. Ibid., p. 1.

31. Ibid., pp. 8–9.

32. Ibid., p. 10.

33. Ibid., p. 9.

34. Ibid., p. 14.

35. Ibid., p. 16.

36. Ibid.

37. Ibid.

38. Ibid., p. 23.

39. Ibid., p. 3.
40. Ibid., p. 23.
41. Ibid.
42. Ibid.
43. Ibid., p. 9.
44. Ibid., p. 27.
45. The article from *Science and Government Report* is reprinted in the *Congressional Record:* U.S., Congress, House, Rep. Les Aspin, Extensions of Remarks, 92d Cong., 2d sess., 18 Aug. 1972, 118: 29244.
46. Shapley, "Herbicides," p. 776.
47. Ibid.
48. Ibid., p. 779.
49. Ibid. Systems Analysis was a division within the Office of the Secretary of Defense.
50. Ibid.
51. *Congressional Record* 118: 29244.
52. Shapley, "Herbicides," pp. 776–777.
53. "Army Study Asks Use of Herbicides," *The Washington Post*, 13 Aug. 1972, p. A–1.
54. *Congressional Record* 118: 29243.
55. Quoted in Shapley, "Herbicides," p. 778.
56. "Army Study Asks Use of Herbicides," p. A–15.
57. ESC, *Herbicides and Military Operations*, II: 19.
58. ESC, *Environmental Aspects of Rome Plow Operations in the Republic of Vietnam*, no. 247 (June 1973), p. A–1; and interview with George H. Orrell, Washington, DC, 7 Oct. 1981. See also Hay, *Tactical and Materiel Innovations*, pp. 87–89.
59. ESC, *Environmental Aspects of Rome Plow Operations*, p. vii.
60. Ibid., p. 15.
61. Ibid., p. ix.
62. ESC, *Infiltration Monitor and Control Systems*, no. 218 (Dec. 1972), p. 3.
63. ESC, *Tactical Evaluation of Sensors*, no. 203 (Mar. 1971).
64. Ibid., p. 10.
65. ESC, *Infiltration Monitor and Control Systems*, p. 4; and interviews with Col. Stewart and Mr. Considine.
66. Project File: The Shape of the Future, 1971, Engineer Studies Center (ESC), Records of the U.S. Army Corps of Engineers, Record Group 77, Washington National Records Center (WNRC), Suitland, MD.
67. Ibid.
68. Interviews with Mr. Orrell and Col. Stewart.
69. Interview with Lloyd B. Addington, Washington, DC, 18 Aug. 1981; M. Scott Peck, "The Role of the Military in American Society vis-à-vis Drug Abuse," in John P. Lovell and Philip S. Kronenberg, eds., *New*

Civil-Military Relations (New Brunswick, NJ: Transaction Books, 1974); and Korb, *The Fall and Rise of the Pentagon*, p. 9.

70. Project File: A Profile of Drug Abuse in the United States, 1972, ESC, RG 77, WNRC; and interview with Mr. Addington.

71. ESC, *A Profile of Drug Abuse in the United States*, no. 231 (May 1972), I: ix.

72. Ibid., p. xi; and interview with Mr. Addington.

73. ESC, *A Profile of Drug Abuse in the United States*, I: 1–2; Project File: A Profile of Drug Abuse in the United States, 1972, ESC, RG 77, WNRC; and interview with Mr. Addington.

74. ESC, *A Profile of Drug Abuse in the United States*, I: 9–38; and interview with Mr. Addington.

75. ESC, *A Profile of Drug Abuse in the United States*, I: 33–57.

76. Ibid., p. 46.

77. Ibid., p. 53.

78. Ibid., p. 97.

79. Ibid., pp. 66–76.

80. Ibid., p. 76.

81. Ibid., p. 84.

82. Ibid., p. 98.

83. Ibid.

84. Ibid., p. 92.

85. ESC, *Bringing a Systems Approach to Drug Abuse Treatment and Rehabilitation Management—An Anthology*, no. 259 (Sept. 1974), pp. 1, A–1, and II–16; and interview with Mr. Addington.

86. ESC, *Bringing a Systems Approach to Drug Abuse Treatment*, p. I–2.

87. Ibid., p. 1. See also the interview with Mr. Addington.

88. ESC, *Bringing a Systems Approach to Drug Abuse Treatment and Rehabilitation—User's Guide to NIDALP*, no. 273 (Feb. 1975); and ESC, *Operator's and Programer's Guide to NIDALP*, no. 268 (Oct. 1975).

89. ESC, *Engineer Estimate, Europe*, no. 210 (Aug. 1971), I: xiii. See also the interviews with Mr. Orrell, Washington, DC, 19 Jan. 1982; Col. John P. Chandler, USA (Ret.), Hill, NH, 27 May 1981; and Mr. Physioc.

90. ESC, *Engineer Estimate, Europe*, I: xiii.

91. Ibid., pp. I, xiv. See also the interview with Col. Chandler.

92. ESC, *Engineer Estimate, Europe*, I: xiv.

93. Ibid., p. 102.

94. Ibid., p. xiv.

95. Ibid.

96. Ibid.

97. ESC, *Providing Integrated Engineer Resources for the Seventies*, no. 241 (Aug. 1973), Executive Summary, p. 1. See also the interview with Mr. Orrell.

98. ESC, *Providing Integrated Engineer Resources for the Seventies*, Executive Summary, pp. 2–4.

99. Ibid., p. 3.

100. Ibid., p. 4.

101. The four task groupings are barriers, roads/airfields/heliports, fortifications, and miscellaneous (camouflaging, ADM operations, river-crossing operations). Ibid., I: 6.

102. Ibid., Executive Summary, p. 6.

103. Ibid., I: 103.

104. Ibid., p. 104.

105. Ibid., Executive Summary, p. 7.

106. ESC, *USAREUR Barrier Concept*, no. 201 (Mar. 1971), pp. 1–2. See also the interviews with Col. Stewart and Robert B. Bockting, Washington, DC, 5 Feb. 1981.

107. ESC, *USAREUR Barrier Concept*, p. 2.

108. Ibid., p. 30.

109. Ibid., pp. 30–31.

110. Ibid., p. 31.

111. Ibid., p. 32.

112. ESC, *Measuring Obstacle Effectiveness*, no. 269 (Mar. 1975), p. A–2.

113. Ibid., p. 3.

114. Project File: Measuring Obstacle Effectiveness, 1975, ESC, RG 77, WNRC.

115. ESC, *Measuring Obstacle Effectiveness*, pp. 33–35.

116. ESC, *Documentation Manual for the USAREUR Barrier Plan ADP System*, no. 255 (July 1974), p. 1.

117. Ibid.; ESC, *USAREUR Barrier Plan Computerization*, no. 238 (Nov. 1973); and ESC, *Barrier Targets, USAREUR Engineer Master List*, no. 261 (Jan. 1974).

118. John J. Tolson, *Air Mobility, 1961–1971*, Vietnam Studies (Washington, DC: Government Printing Office, 1973), pp. 3–24; Hay, *Tactical and Materiel Innovations*, passim; and interviews with Col. Stewart and Mr. Orrell.

119. ESC, *Helicopter Deployment Europe*, no. 220 (Feb. 1972).

120. ESC, *A Preliminary Analysis of Helicopter Test Areas*, no. 232 (Mar. 1972).

121. ESC, *Advanced Attack Helicopter Task Force Report, Appendix I, Incidence of Terrain Masking Opportunities in the USAREUR/Seventh Army Area*, no. 235 (June 1972); and ESC, *Helicopter Masking Analysis*, no. 244 (Mar. 1973). See also the interview with Mr. Greco.

122. ESC, *Advanced Medium STOL Transport Landing Zone Criteria Analysis*, no. 234 (Apr. 1972).

123. Interview with Mr. Greco.

124. ESC, *Military Engineering—An Assessment Methodology*, no. 191 (Mar. 1970).

125. ESC, *U.S. Army Cover and Deception Capabilities*, no. 215 (Jan. 1972); and ESC, *Engineer Cover and Deception Responsibilities*, no. 225 (Sept. 1972).

126. ESC, *Engineer Cover and Deception Responsibilities*, p. 5. See also the interview with Mr. Greco.

127. ESC, *SPECTRUM Validation*, Unnumbered (Mar. 1970); and interview with Mr. Considine.

128. ESC, *Addendum to Portfolio of General Purpose Force Requirements Scenarios*, no. 214 (July 1971); and the interview with Mr. Considine.

129. ESC, *Addendum to Portfolio of General Purpose Force Requirements Scenarios*, p. 3.

130. Interview with Mr. Considine.

131. ESC, *NATO Forces—Central Region*, no. 205 (June 1971); and ESC, *Force Requirements—Northeast Asia*, no. 209 (Aug. 1971).

132. ESC, *NATO Forces—Central Region*, p. 22.

133. ESC, *Army Requirements for POMCUS—Pacific Area*, no. 230 (July 1972).

134. ESC, *Force Requirements—Southeast Asia*, no. 222 (Nov. 1972).

135. ESC, *Conceptual Framework for a Nonlinear War Model*, no. 249 (Apr. 1973).

136. Ibid., p. 4.

137. ESC, *Land Force Requirements for a Combined Defense of Thailand*, no. 242 (Aug. 1973).

138. ESC, *Use of Airborne, Airmobile, and Infantry Divisions in a NATO War*, no. 237 (Aug. 1973), Executive Summary, p. 1.

139. Ibid., I: 301.

140. Ibid., I: xi.

141. Ibid., Executive Summary, p. 12. See also the interview with Mr. Considine.

142. ESC, *Use of Airborne, Airmobile, and Infantry Divisions*, Executive Summary, p. 12.

143. Ibid., I: 34.

144. ESC, *Middle East Scenario*, no. 208 (Jan. 1971).

145. ESC, *Land Force Planning Estimate, Middle East (Case 3)*, no. 270 (Oct. 1975).

146. Annual Historical Summary, FY 75, ESC Historical Files.

147. ESC, *Combat Module Capability Measures*, no. 197 (Oct. 1970). See also the interview with Mr. Considine.

148. ESC, *Combat Module Capability Measures*, p. xv.

149. ESC, *Engineer-Signal Panel*, no. 224 (Sept. 1972).

150. ESC, *Combat-to-Support Ratios*, no. 258 (May 1974), p. 1. For

another discussion of this issue, see Gen. James H. Polk, USA (Ret.), "The New Short War Strategy," *Strategic Review* 3 (Summer 1975): 52–56.

151. In January 1974, ESSG published a related study that compared the capabilities of the Engineer Construction Battalion and the Engineer Combat Battalion in order to determine what changes would be necessary to convert the Construction Battalion to a combat role. ESC, *Construction Battalion in the Combat Engineer Role*, no. 257 (Jan. 1974).

152. ESC, *Combat-to-Support Ratios*, p. 2.

153. Ibid., pp. 3–4.

154. Ibid., p. 7.

155. Ibid., p. 21.

156. Ibid., p. 19.

157. Ibid., p. 20.

158. Ibid., p. 20.

159. Ibid., p. 21.

160. ESC, *Force Stratification Analysis*, no. 254 (May 1974). See also the Project File: Force Stratification Analysis, 1974, ESC, RG 77, WNRC.

161. Project File: Force Stratification Analysis, 1974, WNRC.

162. Ibid. See also interviews with Mr. Considine and Mr. Orrell.

163. ESC, *Force Stratification Analysis*, p. 4.

164. Ibid., p. 5.

165. Ibid., p. 7.

166. Ibid., p. vii. See also interviews with Mr. Considine and Mr. Orrell.

167. ESC, *Force Stratification Analysis*, p. 8. See also the interview with Mr. Considine.

168. Interview with Mr. Orrell, 19 Jan. 1982.

169. ESC, *Force Stratification Analysis*; and ESC, *Force Stratification Analysis, Program Documentation and Operator's Guide*, no. 271 (Sept. 1975).

170. Project File: Force Stratification Analysis, 1974, WNRC; and interviews with Mr. Orrell and Mr. Considine.

171. Interview with Mr. Orrell.

172. ESC, *Integrated Transportation Planning and Its Implications—Analysis and System Proposal*, no. 243 (Apr. 1973).

173. ESC, *Analysis of the Army's Requirement to Own and Operate Watercraft*, no. 263 (Nov. 1974), p. 1.

174. Ibid., p. 7.

175. Interviews with Col. Stewart; Mr. Orrell; Edward W. King, Washington, DC, 13 May 1981; and Col. Chandler.

176. Annual Historical Summary, FY 72, ESC Historical Files.

177. Ibid., FY 70.

178. ESC, *Base Development Planning Manual for CASTLE Users*, no. 229 (Sept. 1972), p. x. See also the interview with Col. Chandler.

179. The ESC *Bibliography* numbers for base development plans are 198 (1970), 213 (1971), 228 (1972), 248 (1973), 260 (1974), and 274 (1975).

180. ESC, *Base Development Planning Assistance Documents*, no. 212 (1971).

181. ESC, *Wartime Lines of Communications, Europe II*, no. 236 (Mar. 1973).

182. ESC, *The Army Base Development Process—A Management Analysis*, Unnumbered (Nov. 1971); and ESC, *Base Development Resource Management*, no. 227 (Feb. 1972).

183. ESC, *The Army Base Development Process*, p. vi.

184. ESC, *Formulations of Objectives for Research and Development*, no. 245 (Dec. 1973).

185. ESC, *Review of Computer Applications and Programs*, no. 252 (Mar. 1974), Annex A.

186. Ibid., p. 52.

187. ESC, *Corps of Engineers Emergency Planning Activities*, no. 256 (Oct. 1974).

188. Ibid., p. 32.

189. Ibid., p. 33.

190. Ibid., p. B-9.

191. ESC, *Contaminated Area Clearance and Land-Use Alternatives*, no. 272 (Jan. 1975).

192. ESC, *Army Installation Sampling and Projections*, no. 275 (Jan. 1975); and ESC, *Army Installation Energy Requirements in CONUS*, no. 276 (Jan. 1975).

193. ESC, *Performance Measurement Study—Industry Survey: A Management Assessment*, Unnumbered (Aug. 1975).

194. Ibid., p. 2.

195. Project File: Performance Measurement Study, 1975, ESC, RG 77, WNRC.

196. Ibid.

197. ESC, *Mobilization Capabilities of the FY 76 Approved Force*, no. 206 (Sept. 1971); and interview with Mr. Considine.

198. ESC, *Force Mobilization Capability Analysis*, no. 223 (Sept. 1972).

199. ESC, *Force Mobilization Capabilities Analysis*, no. 246 (May 1973).

200. Ibid., p. 8.

201. Ibid.

202. Ibid.

203. Ibid., p. 4.

204. ESC, *A Guide for Selective Prepositioning of Army Materiel Configured to Unit Sets*, no. 194 (Feb. 1970). See also the interviews with Col. Chandler and Mr. Greco.

205. ESC, *Realism of Operations Plans for Mating with Pre-Positioned Equipment*, no. 217 (Mar. 1972); and ESC, *Analysis of the Vulnerability of Pre-Positioned Stocks*, no. 233 (Mar. 1972). See also the interviews with Col. Chandler and Mr. Greco.

206. ESC, *Long Range Army Stationing—World and United States Environmental Considerations—2000*, no. 192 (May 1970), p. xiii. The two other studies were ESC, *Insights Applicable to Future Army Stationing*, Unnumbered (1970); and ESC, *Patterns of Transition, The Changing World 1970–2000*, no. 204 (Feb. 1971).

207. ESC, *Patterns of Transition*, p. xiv.

208. Ibid., p. 4.

209. ESC, *Insights Applicable to Future Army Stationing*, p. 12.

210. Ibid.

211. ESC, *Terrain Evaluation for Antiarmor Weapons*, no. 267 (Mar. 1975).

212. ESC, *Underground Nuclear Testing—Environmental Effects (III–VI)*, no. 187 (1970); and *(VII–IX)*, no. 202 (1971).

213. ESC, *Scenario for a Clandestine Nuclear Test*, no. 216 (Jan. 1972). See also the interview with Col. Stewart.

214. ESC, *Scenario for a Clandestine Nuclear Test*, p. 24.

215. ESC, *Potential Sites for Covert Underground Nuclear Testing in USSR, Special Supplements I, II, and III*, no. 253 (Oct. 1973–Aug. 1974).

216. ESC, *Middle East Terrain Analysis*, no. 207 (May 1971).

217. Interview with Col. Stewart and Mr. Orrell.

218. ESC, *United States Involvement in the Middle East—A Framework for Assessment*, no. 266 (Oct. 1975). The earlier study with the same title, no. 251, was published in July 1974.

(Blank)